DEPARTMENT OF MATHEMATICS

SPA

STOCHASTIC PROCESSES AND THEIR APPLICATIONS

32ND CONFERENCE | AUGUST 6–10, 2007

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
05-08-08	Final	12-18-06 to 3-30-08

4. TITLE AND SUBTITLE	
32nd Conference on Stochastic Processes and Their Applications	5a. CONTRACT NUMBER: n/a
	5b. GRANT NUMBER: N00014-07-1-0436
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
Richard B. Sowers	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
University of Illinois at Urbana Champaign 1901 S. First St., Ste A Champaign, IL 61820	

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
Office of Naval Research 875 North Randolph St. Arlington, VA 22203-1995	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release

13. SUPPLEMENTARY NOTES

14. ABSTRACT

See attached program and summary

15. SUBJECT TERMS

Stochastic processes

16. SECURITY CLASSIFICATION OF: a. REPORT	b. ABSTRACT	c. THIS PAGE	17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON	19b. TELEPHONE NUMBER *(Include area code)*
U	U	U	UU		Richard Sowers	217-333-6246

32ND CONFERENCE ON STOCHASTIC PROCESSES AND THEIR APPLICATIONS
N00014-07-1-0436

The 32nd conference on Stochastic Processes and their Applications (SPA'07) was held at the University of Illinois at Urbana-Champaign during the week of August 6-10. The SPA meetings are yearly international events held under the auspices of Committee for Conferences on Stochastic Processes of the Bernoulli Society for Mathematical Statistics and Probability and are co-sponsored by the Institute for Mathematical Statistics (IMS).

The conference was organized by Robert Bauer, Tom Kurtz, Sean Meyn, Renming Song, and Richard Sowers. There were 15 invited speakers, about 20 special sessions, and 150 contributed talks. The invited speakers spoke on a range of topics such as

- abstract stochastic processes
- population models
- stochastic partial differential equations
- stochastic networks.

The sessions (special and contributed) were also dedicated to a variety of subjects; e.g.,

- stochastic Loewner equations
- Levy and stable processes
- abstract stochastic equations
- probability and the Navier-Stokes equation
- random media
- finance
- simulation.

The conference also hosted a number of honors. The 2005 Ito prize was awarded to Nicolai Krylov and the 2007 Ito prize was awarded to Michelle Thieullen and Sylvie Roelly; accompanying lectures were given by Nicolai Krylov and Michelle Thieullen. Russ Lyons and Victor De la Pena both gave IMS Medallion Lectures, and Martin Barlow gave the Lévy Lecture. It was also announced that the 2007 Loeve prize will be awarded to Richard Kenyon.

The inaugural Doob Lecture was given by Marc Yor of the University of Paris VI. This lecture will be held annually at SPA meetings and is supported by the Illinois Journal of Mathematics. The conference also had an NSF-supported roundtable on future directions in probability, organized by Ed Waymire and Philip Protter. This discussion framed some of the current challenges facing probability, both from a funding and curricular standpoint and from the (real or perceived) dichotomy between pure and applied research.

The conference was supported by a number of federal agencies (the Army Research Office, the National Science Foundation, the National Security Agency and the Office of Naval Research) and the Institute for Mathematics and its Applications. A number of campus units also contributed; the Department of Mathematics, the Center for Advanced Study, the Coordinated Science Laboratory, and the Office of the Provost.

For more see http://www.math.uiuc.edu/SPA07/

The organizers would like to thank the ONR for its support of SPA'07.

Welcome to the 32nd Conference on *Stochastic Processes and Their Applications* on the campus of the University of Illinois at Urbana-Champaign! The Department of Mathematics, in Altgeld Hall, will be your host from August 6 to 10, 2007.

The Conference Organizing Committee

Robert Bauer, Department of Mathematics, University of Illinois

Tom Kurtz, Departments of Mathematics & Statistics, University of Wisconsin, Madison

Sean Meyn, Department of Electrical and Computer Engineering, University of Illinois

Renming Song, Department of Mathematics, University of Illinois

Richard Sowers, Department of Mathematics, University of Illinois

The Scientific Committee

Rodrigo Bañuelos (West Lafayette, IN)

Hong Chen (Beijing)

Bob Griffiths (Oxford)

Dima Ioffe (Haifa)

Takashi Kumagai (Kyoto)

Jonathan Mattingly (Durham, NC)

Sean Meyn (Urbana-Champaign, IL)

Yuval Peres (Berkeley, CA)

Richard Sowers (Urbana-Champaign, IL)

Terry Speed (Berkeley, CA)

Bálint Tóth (Budapest)

Maria Eulália Vares (Rio de Janeiro)

John Walsh (Vancouver)

Ed Waymire (Corvallis, OR)

Feng-yu Wang (Beijing)

Martin Zerner (Tübingen)

Support for this conference has been provided by

Army Research Office

Institute for Mathematics and its Application*

National Science Foundation

National Security Agency

Office of Naval Research

Center for Advanced Study
University of Illinois at Urbana-Champaign

Department of Mathematics
University of Illinois at Urbana-Champaign

Department of Electrical & Computer Engineering
University of Illinois at Urbana-Champaign

Coordinated Science Laboratory
University of Illinois at Urbana-Champaign

Office of the Provost
University of Illinois at Urbana-Champaign

Local Arrangements at the University of Illinois

Cheryl A. Barber, Program Director
Conferences & Institutes

Stefanie Meents, Staff Secretary
Conferences & Institutes

*This conference is supported in part by the Institute for Mathematics and its Application (IMA) through its Participating Institution (PI) Program.

In Memoriam

Catherine Doléans-Dade

Joseph L. Doob

Frank B. Knight

Walter Philipp

Table of Contents

Conference Schedule

All Invited Speakers' sessions will meet in Room 314 Altgeld Hall.

8.6.07 | MONDAY

7:30 AM–5:00 PM
Registration
Illini Union West Hallway by Illini Rooms ABC

8:15–8:30 AM
Conference opens

8:30–9:15 AM
Random Metrics and Geometries in Two Dimensions
Scott Sheffield, Courant Institute of Mathematical Sciences, New York University

9:25–10:10 AM
Quasi-Stationary Distributions and Diffusion Models in Population Dynamics
Sylvie Meleard, École Polytechnique, Palaiseau, France

10:10–10:40 AM
Refreshment break/visit exhibits and displays

10:40–11:25 AM
IMS Medallion Lecture
Unimodularity and Stochastic Processes
Russ Lyons, Indiana University

11:35–12:20 PM
Abelian Sandpiles on Infinite Graphs
Antal Jarai, Carleton University, Ontario, Canada

12:20–2:00 PM
Lunch on your own

2:00–3:30 PM
Special and Contributed Sessions (see pages 8–11)

3:30–4:00 PM
Refreshment break/visit exhibits and displays

4:00–5:55 PM
Special and Contributed Sessions (see pages 8–11)

6:00 PM
Wine and Cheese Reception at the Illini Union

8.7.07 | TUESDAY

8:00 AM–5:00 PM
Registration
Illini Union West Hallway by Illini Rooms ABC

8:30–9:15 AM
On Stochastic Partial Differential Equations
Nikolai Krylov, University of Minnesota, Minneapolis (2005 Ito Prize)

9:25–10:10 AM
Interacting Brownian Motions Related to Random Matrices
Hirofumi Osada, Kyushu University, Japan

10:10–10:40 AM
Refreshment break/visit exhibits and displays

10:40–11:25 AM
Current Large Deviations in Stochastic Systems
Thierry Bodineau, Université de Paris 6 and 7, France

11:35–12:20 PM
Integral Formulas for the Asymmetric Simple Exclusion Process
Craig Tracy, University of California, Davis

12:20–2:00 PM
Lunch on your own

2:00–3:30 PM
Special and Contributed Sessions (see pages 8–11)

3:30–4:00 PM
Refreshment break/visit exhibits and displays

4:00–5:55 PM
Special and Contributed Sessions (see pages 8–11)

8.8.07 | WEDNESDAY

8:00 AM–5:00 PM
Registration
Illini Union West Hallway by Illini Rooms ABC

8:30–9:15 AM
Inaugural Doob Lecture
J. L. Doob and Stochastic Processes
Marc Yor, Université de Paris 6, France

9:25–10:10 AM
Invasion Percolation on Regular Trees
Gordon Slade, University of British Columbia, Canada

10:10–10:40 AM
Refreshment break/visit exhibits and displays

10:40–11:25 AM
Recent Progress on Reinforced Random Walks
Silke Rolles, Technische Universität München, Germany

11:35–12:20 PM
Spreading Rumors in Moving Populations
Vladas Sidoravicius, IMPA, Brazil

12:20–2:00 PM
Lunch on your own

2:00–2:45 PM
Ancestral Processes in Population Genetics—Exchangeable Coalescents
Martin Moehle, University of Düsseldorf, Germany

2:50–3:35 PM
Lévy Lecture
Random Walks, Percolation, and the Random Conductance Model
Martin Barlow, University of British Columbia, Canada

3:40–6:00 PM
Roundtable in 314 Altgeld Hall

7:00 PM
Banquet at the Illini Union

8.9.07 | THURSDAY

8:00 AM–5:00 PM
Registration
Illini Union West Hallway by Illini Rooms ABC

8:30–9:15 AM
2007 Ito Prize
(jointly awarded to Michelle Thieullen and Sylvie Roelly)
Integration by Parts Formula on the Path Space and Bridges of Brownian Diffusions
Michelle Thieullen, Université de Paris 6 and 7, France

9:25–10:10 AM
Central Limit Theorems for Functionals of Gaussian Processes and Applications
David Nualart, University of Kansas

10:10–10:40 AM
Refreshment break/visit exhibits and displays

10:40–11:25 AM
Quality and Efficiency Driven Call Centers
Avishai Mandelbaum, Technion, Israel Institute of Technology

11:35–12:20 PM
Asymptotic Stability of Nonlinear Filters in Hidden Markov Models and Its Applications
Tze Leung Lai, Stanford University

12:20–2:00 PM
Lunch on your own

2:00–3:30 PM
Special and Contributed Sessions (see pages 8–11)

3:30–4:00 PM
Refreshment break/visit exhibits and displays

4:00–5:55 PM
Special and Contributed Sessions (see pages 8–11)

8.10.07 | FRIDAY

8:00–10:00 AM
Registration
Illini Union West Hallway by Illini Rooms ABC

8:30–9:15 AM
Heat Kernel Analysis on Loop Groups
Shizan Fang, Université de Bourgogne, France

9:25–10:10 AM
Ricci Curvature of Markov Chains
Yann Ollivier, ENS de Lyon, France

10:10–10:40 AM
Refreshment break/visit exhibits and displays

10:40–11:25 AM
IMS Medallion Lecture
Back-Testing of VaR Models: A Tale of Two Powers
Victor de la Peña, Columbia University

11:35–12:20 PM
Resource Control in Stochastic Networks: Asymptotic Optimality
David Yao, Columbia University, New York

12:20–2:00 PM
Lunch on your own

2:00–4:25 PM
Special and Contributed Sessions (see pages 8–11)

4:30 PM
Conference closes

Invited Speakers' Abstracts

Random Metrics and Geometries in Two Dimensions

Scott Sheffield, Courant Institute of Mathematical Sciences, New York University

Quasi-Stationary Distributions and Diffusion Models in Population Dynamics

Sylvie Meleard, École Polytechnique, Palaiseau, France

We study quasi-stationarity for a large class of Kolmogorov diffusions, that is convergence to equilibrium conditioned to non-extinction. These diffusions arise from population dynamics and are obtained from generalized (as for example logistic) Feller diffusions. We firstly study in details the one-dimensional case. The main novelty is that the drift term may explode at the origin and the diffusion may have an entrance boundary in infinity. We obtain conditions on the drift for the existence of quasi-stationary distributions, as well as rate of convergence, and existence of the process conditioned to be never extinct. We show that under these conditions, there is exactly one conditional limiting distribution (which implies uniqueness of the quasi-stationary distribution) if and only if the process comes down from infinity. The proofs are based on spectral theory. Next, we show that our tools allow us to consider an appropriate multi-dimensional framework related to interesting examples from population dynamics. The uniqueness is then related to the ultracontractivity of the semigroup of the killed process.

IMS Medallion Lecture

Unimodularity and Stochastic Processes

Russ Lyons, Indiana University

Stochastic processes on vertex-transitive graphs, especially Cayley graphs of groups, have been studied for 50 years (not counting the special case of integer lattices, which goes back hundreds of years). The assumption of invariance under graph automorphisms plays a key role, but investigations of the last 15 years have shown that an additional assumption is also extremely useful. This newer assumption is the property of unimodularity, which is equivalent to the Mass-Transport Principle. We shall review some well-known applications and also discuss recent work with David Aldous.

Abelian Sandpiles on Infinite Graphs

Antal Jarai, Carleton University

The Abelian "sandpile," introduced by physicists Bak, Tang and Wiesenfeld in 1987, plays the role of a toy model for how complex behaviour, characterized by long range correlations, can arise naturally from simple local dynamical rules. In the first introductory part of the talk, I will survey some of the key results known for this model. In the second part, I will address the question: what happens in the limit when the finite graph on which the model is originally defined approaches an infinite graph? A few open problems, easily understandable to the non-specialist, will be mentioned during the talk.

On Stochastic Partial Differential Equations

Nicolai Krylov, University of Minnesota, Minneapolis (2005 Ito Prize)

We are going to discuss some problems leading to SPDEs arising from filtering theory of diffusion processes and populational dynamics. Equation in the whole space and in domains will be considered and some recent progress concerning the continuity properties of solutions in the closure of domains will be reported. In particular, the relevance of a new square root law for one-dimensional Brownian motion will be explained.

Interacting Brownian Motions Related to Random Matrices

Hirofumi Osada, Kyushu University, Japan

Interacting Brownian motions are an infinite number of Brownian particles moving in Euclidean spaces with the effect of interaction potentials. In this talk we consider two classes of interacting Brownian motions. One has Gibbs equilibrium measures and other has equilibrium measures with logarithmic (2D Coulomb) potentials. The later measures appear in the thermodynamic limit of the spectrum of random Gaussian matrices.

The first class is the standard one for interacting Brownian motions in the sense that each particle converges to a Brownian motion under diffusive scaling (of at least more than one dimension). We can see this by considering the homogenization and the tagged particle problem. As for the second class, we see a big difference in the dynamical properties to those of the first class because of the strong, long range effects of logarithmic potentials.

Current Large Deviations in Stochastic Systems

Thierry Bodineau, Université de Paris 6 and 7, France

Using the framework of the hydrodynamic limits, we will review recent results on the large deviations of the current for stochastic particle systems. In particular, we will discuss the dynamical phase transitions which occur for some stochastic models.

Integral Formulas for the Asymmetric Simple Exclusion Process

Craig Tracy, University of California, Davis

Since its introduction nearly forty years ago by Frank Spitzer, the asymmetric simple exclusion process (ASEP) has become the "default stochastic model for transport phenomena." In this talk we consider the ASEP on the integer lattice with nearest neighbor hopping rates and present general integral formulas for various probabilities. This is joint work with Harold Widom.

Inaugural Doob Lecture

J. L. Doob and Stochastic Processes

Marc Yor, Université de Paris 6, France

In this lecture, I shall discuss some of the achievements of J. L. Doob concerning stochastic processes and their influence on the development of Probability Theory.

Invasion Percolation on Regular Trees

Gordon Slade, University of British Columbia, Canada

We consider invasion percolation on a rooted regular tree. For the infinite cluster invaded from the root, we identify the scaling behavior of its multi-point functions, and of its volume both at a given height and below a given height. We find that while the power laws of the scaling are the same as for the incipient infinite cluster for ordinary percolation, the scaling functions differ. Thus, somewhat surprisingly, the invasion percolation cluster and the incipient infinite cluster are globally different, in fact mutually singular. In addition, we use recent work of Barlow, Jarai, Kumagai and Slade to analyse simple random walk on the invasion percolation cluster, and show that the spectral dimension is 4/3. This is joint work with Omer Angel, Jesse Goodman and Frank den Hollander.

Recent Progress on Reinforced Random Walks

Silke Rolles, Technische Universität München, Germany

During the past 20 years, random processes with reinforcement have been an active area of research. In the talk, I will report on one particular model, called linearly edge-reinforced random walk, which was introduced by Diaconis in 1986. Around 20 years ago, Diaconis asked whether in two dimensions the edge-reinforced random walk is recurrent, i.e. returns to its starting point with probability one. This question is still open. However, during the past years, recurrence was proved on ladders of arbitrary finite width, and more recently, for a class of two-dimensional graphs. In the talk, I will present some of these recent developments.

This is joint work with Franz Merkl.

Spreading Rumors in Moving Population

Vladas Sidoravicius, IMPA, Brazil

We consider several classes of spatial stochastic processes which can be represented and studied as growth processes in a random environment determined by an infinite system of interacting random walks. Varying the interaction, this representation covers Diffusion Limited Aggregation (DLA) type growth, Stochastic Sandpiles, models of ad hoc wireless networks and many more. The distinct characteristic of these systems is that due to the nature of the interaction between the growing aggregate and the surrounding environment, in most cases they do not possess obvious parameters which satisfy subadditive ergodic theorem. Therefore many traditional methods and techniques are not applicable. During my talk I will address these questions, and describe several new results and techniques. Joint work with Harry Kesten.

Ancestral Processes in Population Genetics—Exchangeable Coalescents

Martin Moehle, University of Düsseldorf, Germany

Coalescents are partition-valued Markovian processes with a block-merging transition mechanism. During each transition blocks merge into single blocks. These processes can arise in the limit as the total population size tends to infinity when studying the genealogy of a sample of individuals from an exchangeable finite population.

Coalescents play an important role in the theory of coagulation and fragmentation. They have remarkable relations to measure-valued processes, random recursive trees and other combinatorial objects such as partition structures and sampling formulas. This talk introduces into the theory of coalescents and reviews recent mathematical research and biological applications around these stochastic processes.

Lévy Lecture

Random Walks, Percolation, and the Random Conductance Model

Martin T. Barlow, University of British Columbia, Canada

Consider the standard Euclidean lattice, and put random i.i.d. 'conductances' V(e) on each bond. We allow the possibility that V(e) is zero. Let Y be a continuous time Markov chain which jumps from a vertex x to a neighbour y with probability proportional to V(xy). We assume that the holding time in x is exponential with rate W(x). There are two natural choices for W. The first, (the `constant speed walk'), has W(x)=1 for all x. The second, (the `variable speed walk') is obtained by taking W(x) to be the sum of the conductivities of the edges adjacent to x.

We assume that the probability that V(e) is positive is greater than p_c, the critical probability for bond percolation on the Euclidean lattice. Thus there exists (a.s.) a unique infinite connected subgraph on which Y can run. A special case of the above is when V(e) is either 0 or 1, and so Y is a random walk on a supercritical percolation cluster. Various kinds of 'trapping' can arise if V(e) can take either small positive values, or large values. In this talk I will discuss invariance principles for Y, and Gaussian bounds for its transition densities.

2007 Ito Prize

(jointly awarded to Michelle Thieullen and Sylvie Roelly)

Integration by Parts Formula on the Path Space and Bridges of Brownian Diffusions

Michelle Thieullen, Université de Paris 6 and 7, France

In this talk we consider families of time Markov fields (also called reciprocal processes) on [0,1] which have the same bridges as Brownian diffusions. We characterize each family as the set of probability measures on the path space C([0,1]; R^d) under which a particular integration by parts formula holds. We present applications of this result to the following topics: periodic Ornstein-Uhlenbeck process, existence of Nelson derivatives, characterization of gradient drifts and generalization of a result of Kolmogorov on reversibility.

Central Limit Theorems for Functionals of Gaussian Processes and Applications

David Nualart, University of Kansas

Consider a sequence of multiple stochastic integrals of fixed order n greater or equal than 2, and with unit variance. Then, this sequence converges in distribution to a standard normal law if and only if one of the three equivalent conditions hold: (i) The fourth order cumulants converge to zero. (ii) For any p beetween 1 and n-1, the contractions of p indices of the kernels of the multiple stochastic integrals converge to zero. (iii) The square of the norm of the derivatives in the sense of Malliavin calculus converge a constant in mean square. This result can be extended to the case of multidimensional sequences and it can be used to provide useful criteria for the chaotic central limit to hold for general sequences of square integrable random variables. The aim of this talk is to present some recent applications of these criteria. In particular, we will discuss the asymptotic behaviour of quantities such as the p-variation of stochastic integrals and the renormalized self-intersection local time of the fractional Brownian motion.

Quality- and Efficiency-Driven Call Centers

Avishai Mandelbaum, Technion, Israel Institute of Technology

Through examples of Service Operations, with a focus on Telephone Call Centers, I review empirical findings that motivate or are motivated by (or both) interesting research questions. These findings give rise to features that are prerequisites for useful service models, for example customers' (im)patience, time-varying demand, heterogeneity of customers and servers, over-dispersion in Poisson arrivals, generally-distributed (as opposed to exponential) service- and patience-durations, and more. Empirical analysis also enables validation of existing models and protocols, either supporting or refuting their relevance and robustness.

The mathematical framework for my models is asymptotic queueing theory, where limits are taken as the number of servers increases indefinitely, in a way that maintains a delicate balance against the offered-load. Asymptotic analysis reveals an operational regime that achieves, under already moderate scale, remarkably high levels of both service quality and efficiency. This is the QED Regime, discovered by Erlang and characterized by Halfin and Whitt. (QED = Quality- and Efficiency-Driven).

My main data-source is a unique repository of call-centers data, designed and maintained at the Technion's SEE Laboratory. (SEE = Service Enterprise Engineering). The data is unique in that it is transaction-based: it details the individual operational history of all the calls handled by the participating call centers. (For example, one source of data is a network of 4 call centers of a U.S. bank, spanning 2.5 years and covering about 1000 agents; there are 218,047,488 telephone calls overall, out of which 41,646,142 were served by agents, while the rest were handled by answering machines.) To support data analysis, a universal data-structure and a friendly interface have been developed, under the logo DataMOCCA = Data MOdels for Call Centers Analysis. (I shall have with me DataMOCCA DVD's for academic distribution.)

Asymptotic Stability of Nonlinear Filters in Hidden Markov Models and Its Applications

Tze Leung Lai, Stanford University

After a brief review of previous works on asymptotic stability of the Kalman filter and nonlinear filters in hidden Markov models (HMM), we describe a new approach to proving asymptotic stability of HMM filters for general state spaces. The basic idea is to regard the HMM filter as a measure-valued Markov chain and to use modified Foster-Liapounov functions, coupling and regeneration arguments to derive the asymptotic stability of the HMM filter from that of the underlying Markov chain. Applications of the result to asymptotic efficiency of maximum likelihood estimators in HMM on general state space models and to sequential Monte Carlo methods are also given.

Heat Kernel Analysis on Loop Groups

Shizan Fang, Université de Bourgogne, France

We will give a survey on stochastic analysis about heat kernel measures on the loop group over a compact Lie group. More precisely, our exposition will be on the logarithmic Sobolev inequality, transportation cost inequalities as well as the construction of the optimal maps for the Monge-Kantorovich problem.

Ricci Curvature of Markov Chains

Yann Ollivier, ENS de Lyon, France

We define the Ricci curvature of Markov chains on metric spaces as a local contraction coefficient of the random walk acting on the space of probability measures equipped with a Wasserstein transportation distance. For Brownian motion on a Riemannian manifold this gives back the value of Ricci curvature of a tangent vector. The discrete cube and discrete versions of the Ornstein-Uhlenbeck process are positively curved. Bakry-Emery curvature is recovered. Positive Ricci curvature is shown to imply a spectral gap, a Lévy-Gromov Gaussian concentration theorem and a kind of logarithmic Sobolev inequality.

IMS Medallion Lecture

Back-Testing of VaR Models: A Tale of Two Powers

Victor de la Peña, Columbia University

In this talk I will show how using elementary probability arguments one can improve on the Word Standard for Banking Supervision.

Resource Control in Stochastic Networks: Asymptotic Optimality

David Yao, Columbia University

We study a stochastic network that consists of a set of servers processing multiple classes of jobs. Each class of jobs requires a concurrent occupancy of several servers while being processed, and each server's capacity is shared among the job classes in a head-of-the-line processor-sharing mechanism. The allocation of service capacities is a real-time control mechanism, taking the form of a solution to a utility-maximizing problem in each network state. Whereas this allocation optimizes in a ``greedy" fashion (i.e., with respect to each state), we establish its asymptotic optimality in terms of deriving the fluid and diffusion limits of the network under this allocation scheme, and identifying a cost objective that is minimized in the diffusion limit, along with a characterization of the so-called fixed-point state of the network. (Joint work with Hengqing Ye of the National University of Singapore and the Hong Kong Polytechnic University.)

Special Sessions Schedule

Abstract Number given in ( ) after Author's Name

8.6.07 | MONDAY

Special Session I

SLE and Related Processes 245AH

2:00–2:25 PM Lawler (960)
2:30–2:55 PM Bauer (469)
3:00–3:25 PM Kozdron (891)

Path Properties of Levy Processes 1 241AH

2:00–2:25 PM Schilling (422)
2:30–2:55 PM Rivero (47)
3:00–3:25 PM Yang (740)

Stochastic Equations 1 243AH

2:00–2:25 PM Mueller (783)
2:30–2:55 PM Viens (609)
3:00–3:25 PM Kurtz (587)

Special Session II

Potential Theory for Jump Processes 1 241AH

4:00–4:25 PM Vondracek (622)
4:30–4:55 PM Panki Kim (395)
5:00–5:25 PM Mendez (512)

Stochastic Equations 2 243AH

4:00–4:25 PM Ma (134)
4:30–4:55 PM Sundar (278)

8.7.07 | TUESDAY

Special Session I

Stochastic Equations 3 241AH

2:00–2:25 PM Cherny (377)
2:30–2:55 PM Wolf (355)
3:00–3:25 PM Engelbert (399)

Path Properties of Levy Processes 2 243AH

2:00–2:25 PM Chaumont (723)
2:30–2:55 PM Caballero (641)

Stochastic Models for Market Microstructure 143AH

2:00–2:25 PM Cotar (310)
2:30–2:55 PM Hayashi (698)
3:00–3:25 PM Viarengo (490)

Special Session II

Probability & Navier Stokes Equations 1 241AH

4:00–4:25 PM Iyer (758)
4:30–4:55 PM Ossiander (150)
5:00–5:25 PM Orum (898)
5:30–5:55 PM Bessaih (590)

SPDE's & Gaussian Analysis 243AH

4:00–4:25 PM Xiao (990)
4:30–4:55 PM Dongsheng Wu (249)
5:00–5:25 PM Viens (79)
5:30–5:55 PM Foondun (423)

Geometry and Probability 245AH

4:00–4:25 PM Cecil (100)
4:30–4:55 PM Gordina (914)
5:00–5:25 PM Baudoin (303)
5:30–5:55 PM Lescot (485)

8.9.07 | THURSDAY

Special Session I

Potential Theory for Jump Processes 2 241AH

2:00–2:25 PM Kassmann (10)

2:30–2:55 PM Bogdan (568)

Probability & Navier Stokes Equations 2 245AH

2:00–2:25 PM Waymire (725)

2:30–2:55 PM Bakhtin (674)

3:00–3:25 PM Duan (739)

Martingale Approximation & Limit Theorems 243AH

2:00–2:25 PM Woodroofe (542)

2:30–2:55 PM Volny (697)

3:00–3:25 PM Wei Biao Wu (993)

Special Session II

Potential Theory for Jump Processes 3 241AH

4:00–4:25 PM Uemura (336)

4:30–4:55 PM Song (279)

5:00–5:25 PM Ryznar (261)

Mathematical Finance 1 245AH

4:00–4:25 PM Linetsky (44)

4:30–4:55 PM Bayraktar (717)

5:00–5:25 PM Mocioalca (655)

5:30–5:55 PM Kyounghee Kim (349)

Random Media 1 243AH

4:00–4:25 PM Koralov (517)

4:30–4:55 PM Bakhtin (189)

5:00–5:25 PM Kosygina (437)

5:30–5:55 PM Viens (257)

8.10.07 | FRIDAY

Special Session I

Random Media 2 241AH

2:00–2:25 PM Molchanov (759)

2:30–2:55 PM Ben-Ari (685)

3:00–3:25 PM Seppalainen (413)

Mathematical Finance 2 245AH

2:00–2:25 PM Goodman (684)

2:30–2:55 PM Tehranchi (995)

3:00–3:25 PM Cheridito (985)

3:30–3:55 PM Protter (52)

Contributed Sessions Schedule

Abstract Number given in ( ) after Author's Name

8.6.07 | MONDAY

Contributed Session I

Population Genetics 143AH

2:00–2:25 PM Diaz (30)
2:30–2:55 PM Schweinsberg (262)
3:00–3:25 PM Stanek (392)

Stationary Processes 145AH

2:00–2:25 PM Rezakhah (137)
2:30–2:55 PM Zhao (667)
3:00–3:25 PM Soltani (59)

Contributed Session II

Finance 1 245AH

4:00–4:25 PM Yingying Li (830)
4:30–4:55 PM Kiseop Lee (892)
5:00–5:25 PM Florescu (950)
5:30–5:55 PM Ludkovski (202)

Statistics 1 143AH

4:00–4:25 PM Bradley (525)
4:30–4:55 PM Figueroa-Lopez (105)
5:00–5:25 PM Russo (190)
5:30–5:55 PM Gabrys (757)

Applied Probability 145AH

4:00–4:25 PM Weerasinghe (362)
4:30–4:55 PM Ross (883)
5:00–5:25 PM Linn (340)
5:30–5:55 PM Ghosh (467)

8.7.07 | TUESDAY

Contributed Session I

Stochastic Geometry 145AH

2:00–2:25 PM Huiling Le (375)
2:30–2:55 PM Pawlas (576)
3:00–3:25 PM Helisova (195)

Finance 2 245AH

2:00–2:25 PM Sotomayor (984)
2:30–2:55 PM Akcay (292)
3:00–3:25 PM Choong Soo Lee (06)

Contributed Session II

Jump Processes 143AH

4:00–4:25 PM Hinz (460)
4:30–4:55 PM Vinogradov (94)
5:00–5:25 PM Utzet (923)

Statistics 2 145AH

4:00–4:25 PM Roellin (155)
4:30–4:55 PM Balaji (354)
5:00–5:25 PM Van Zanten (128)
5:30–5:55 PM Ertefaie (881)

Random Walks 1 147AH

4:00–4:25 PM Zheng (624)
4:30–4:55 PM Joseph (90)

8.9.07 | THURSDAY

Contributed Session I

Stochastic Analysis 1 143AH

2:00–2:25 PM	Didier (26)
2:30–2:55 PM	Mayer-Wolf (282)
3:00–3:25 PM	Herbin (461)

Random Walks 2 145AH

2:00–2:25 PM	Chen (415)
2:30–2:55 PM	Roitershtein (951)
3:00–3:25 PM	Peterson (80)

Contributed Session II

Trees 143AH

4:00–4:25 PM	Witkowski (108)
4:30–4:55 PM	Dhersin (888)
5:00–5:25 PM	del Puerto (846)
5:30–5:55 PM	Lladser (343)

SPDE's & Interacting Particle Systems 145AH

4:00–4:25 PM	Gautier (197)
4:30–4:55 PM	Fontbona (611)
5:00–5:25 PM	Bonnet (634)
5:30–5:55 PM	Maroulas (767)

8.10.07 | FRIDAY

Contributed Session

Simulation 143AH

2:00–2:25 PM	Jain (952)
2:30–2:55 PM	Kovchegov (476)
3:00–3:25 PM	Guan (149)
3:30–3:55 PM	Lladser (616)

Stochastic Analysis 2 145AH

2:00–2:25 PM	Van Gaans (323)
2:30–2:55 PM	Stojkovic (424)
3:00–3:25 PM	Peligrad (994)
3:30–3:55 PM	Goodman (893)
4:00–4:25 PM	Aryal (813)

Applied Probability 147AH

2:00–2:25 PM	Buche (804)
2:30–2:55 PM	Kang (614)
3:00–3:25 PM	Abdeldjebbar (318)
3:30–3:55 PM	Bhamidi (420)
4:00–4:25 PM	Bongolan (520)

Conference Abstracts

06 Dynamic Partner Selection and Management System

Choong Soo Lee, Dept of e-Business, Gwangju University, Korea

We propose a dynamic partner selection and management (DPSM) system for supporting a partner selection process in virtual enterprise environment. The DPMS system evaluates partners' supply capabilities and market condition changed over the period in time with multi-criteria, quantitative criteria and qualitative criteria. The system helps selecting the optimal partners for maximizing revenue under a low level of risk.

The research fields of partner selection are divided into five parts: problem definition, formulation of criteria, prequalification, and final selection. Especially, prequalification and final choice is actively pursued in this paper.

The proposed system has been applied to partner selection problem under the supply chain of Agriculture industry in Korea and to compare the performance of our model to that of an existing model.

10 Fine Regularity Properties for Resolvents of Non-Local Dirichlet Forms

Moritz Kassmann, Institut für Angewandte Mathematik, Universität Bonn, Germany

In recent years there has been increasing interest in studying non-local Dirichlet forms generating Markov jump processes. So far, all approaches use (at least partly) the corresponding stochastic processes and probabilistic methods. The aim of this talk is to show that the methods of E. De Giorgi and J. Moser are applicable, too. Applying these methods, we are able to prove Hoelder regularity of functions which are harmonic with respect to the Dirichlet forms under consideration. The approach allows to deal with jump kernels that could not have been dealt with so far. We also shed some light in the question how Harnack inequalities and Hoelder regularity are related.

26 On Operator Fractional Brownian Motions

Gustavo Didier, Statistics and OR, University of North Carolina, Chapel Hill

We obtain several new results on operator fractional Brownian motions, which are Gaussian operator self-similar processes with stationary increments, and are multivariate analogues of the one-dimensional fractional Brownian motion. We establish integral representations of operator fractional Brownian motions, study their basic properties, examine questions of uniqueness of representation and discuss connections with multivariate long range dependent time series.

30 Application of the Twin Illness-Death Competing Risk Process

Mireya Diaz, Epidemiology and Biostatistics, Case Western Reserve University

Complex time-to-event data commonly arise in medical and biological data. One such scenario is the one posed by bivariate competing risk events or twin illness-death competing risk processes, as observed with several types of an outcome in similar organs of an individual. Under this setting, a progressive Markov chain provides an elegant and flexible formulation. A general model was developed in order to assess the effects of different aspects of the process, such as correlation between events, rate of competing risks, censoring, organ symmetry and sample size on the estimates of transition probabilities. Then via simulations, these factors are examined under controlled conditions. When correlation between cluster components is weak the stationary distribution in terms of the failure cause tends to the distribution observed in an offspring's locus from heterozygous parents, and the events rarely occur simultaneously. Sample size and censoring affect the bias of the estimates in opposite directions under this condition. When the correlation of events between organs increases, the stationary distribution loses this equilibrium leaning towards simultaneous and same-cause events. Future work will extend the model to deal with cluster asymmetry, new clocks, oscillation, and covariates.

44 Time Changed Markov Processes in Mathematical Finance

Vadim Linetsky, Industrial Engineering and Management Sciences, Northwestern University

The procedure of time changing a stochastic process, going back to S. Bochner, allows one to construct new processes from a given process by running it on a new clock. When the process to be time changed is a Markov process and the Laplace transform of the time change is known, there is an explicit representation of the expectation operator of the time changed process in terms of the resolvent of the original Markov process and the Laplace transform of the time change. We use this result to build a rich tool box of analytically tractable asset pricing models in finance that incorporate stochastic volatility, state-dependent jumps, and state-dependent killing rates (or default intensities). Among the resulting models is a new credit-equity model that is an extension of the constant elasticity of variance (CEV) model with stochastic volatility, jumps, and default, as well as extensions of the Cox-Ingersoll-Ross and the Ornstein-Uhlenbeck models with mean-reverting jumps.

47 On Some Transformations between Positive Self-Similar Markov Processes

Víctor Rivero, Probability and Statistics, Centro de Investigación en Matemáticas A.C., Mexico

A path decomposition at the infimum for positive self-similar Markov processes (pssMp) is obtained. Next, several aspects of the conditioning to hit 0 of a pssMp are studied. Associated to a given pssMp X that never hits 0, we construct a pssMp Y that hits 0 in a finite time. The latter can be viewed as Y conditioned to hit 0 in a finite time and we prove that this conditioning is determined by the pre-minimum part of Y.

Finally, we provide a method for conditioning a pssMp that hits 0 by a jump to do it continuously.

52 Modeling Financial Bubbles

Philip Protter, OR&IE, Cornell University

Financial bubbles have long plagued investors, and even entire economies. The modern theory of the absence of arbitrage provides a way to understand what they are, and when they occur, in a mathematics framework. The theory of F. Delbaen and W. Schachermayer states that an absence of arbitrage is equivalent to the existence of a risk neutral measure that turns the process in question into a sigma-martingale. The determination of which type of sigma martingale applies in the case in question allows one to analyze whether or not a bubble exists. Previous work is in the complete case, and perversely under Mertons "No Dominance" assumption, bubbles cannot exist in complete markets, except for fiat money. We will explain how bubbles can be "born," through a process roughly analogous to a phase change in Ising models. This talk is based on joint work with Kazuhiro Shimbo and Robert Jarrow.

59 Time Domain Interpolation Recipe for Innovations of Discrete Time Multivariate Stationary Processes

Ahmad Reza Soltani, Statistics and OR, Kuwait University

Time domain calculus of Wiener and Masani together with the von Neumanns alternative projection formula are employed to obtain a time domain recipe formula for the best linear interpolator of unrecorded innovations in discrete time multivariate second order stationary processes. Then a recursive interpolation procedure for multivariate discrete time ARMA models is derived.

79 Superdiffusivity for a Brownian Polymer in a Continuous Gaussian Environment

Frederi Viens, Statistics, Purdue University

We describe the asymptotic behavior of a one-dimensional Brownian polymer in random medium represented by a Gaussian field with positive time parameter and real space parameter. The random medium is assume to be white noise in time and function-valued in space. According to the behavior of the spatial covariance of this noise, we give a lower bound on the power growth (wandering exponent) of the polymer when the time parameter goes to infinity: the polymer is proved to be superdiffusive, with a wandering exponent exceeding any value less than 3/5. This result is obtained by assuming that the spatial covariance function decays faster than cubically at infinity. For any decay that is faster than the power 5/2 but slower than cubic, we still obtain superdiffusivity, i.e. a wantering exponent greater than 1/2, but we cannot get arbitrarily close to 3/5. This is joint work with Dr. Sergio Bezerra and Prof. Samy Tindel.

This talk to be presented at SPA 07 in the special session organized by Michael Cranston and Leonid Koralov.

80 Quenched Limits for Transient, Zero-Speed One-Dimensional Random Walk in Random Environment

Jonathon Peterson, Mathematics, University of Minnesota

We consider a nearest-neighbor, one-dimensional random walk {X(n)} in a random i.i.d. Environment, in the regime where the walk is transient but with zero speed, so that X(n) is of order n^s for some s<1. Kesten, Kozlov, and Spitzer (1975) proved that annealed (averaged over all environments) the random walk scaled by n^s converges in distribution to a random variable related to a completely asymmetric s-stable distribution. We show that under the quenched law (i.e. Conditioned on the environment) no limit laws are possible: there exist sequences {n(k)} and {x(k)} depending on the environment only, such that (X(n(k)) - x(k)) = o(log n(k))^2 (a localized regime). On the other hand, there exist sequences {t(m)} and {s(m)} depending on the environment only, such that log(s(m))/log(t(m)) -> s and P(X(t(m)) / s(m) ? x) -> ½ for all x >0 and -> 0 for all x ? 0 (a spread out regime). This is joint work with Ofer Zeitouni.

90 Fluctuations of the Quenched Mean of a Random Walk in a Space Time Random Environment.

Mathew Joseph, Mathematics, University of Wisconsin, Madison

We consider a random walk in a two dimensional random environment which moves in the positive e_2 direction. We prove a CLT for the mean position of the walk (given the environment) on crossing level n.

94 On Local Theorems for Distributions of some Lévy and Markov Processes

Vladimir Vinogradov, Mathematics, Ohio University

We combine the Poisson mixture representation technique with Laplace method to derive new local limit theorems for several stochastic models. They include Lotkas model on the extinction probability for American male lines of descent, branching-fluctuating particle systems in the case of convergence to either super-Brownian motion or a discontinuous superprocess, natural exponential family of Lévy processes whose distributions belong to Sichels class. A modification of Gnedenkos method of accompanying infinitely divisible laws makes it possible to extend our results to additional classes of Lévy and Markov processes. One of them is related to gamblers ruin problem providing the rate of convergence in a classical Bacheliers result.

100 On the Riemannian Geometry of Path Groups

Matthew Cecil, Mathematics, University of Connecticut

Let G be a connected Lie group with left-invariant inner product. We examine the Riemannian geometry of the pinned path group of G by using natural finite dimensional approximations based on a partition of [0,1]. In particular, we are interested in proving lower bounds of Ricci curvature independent of partition, a condition which appears necessary for stochastic analysis on such path groups. The case of G compact with Ad-invariant inner product has been treated extensively in the literature. We are interested in extending the class of groups G for which such bounds exist.

105 Non-Parametric Estimation for Some Models Driven by Levy Processes

Jose Figueroa-Lopez, Statistics, Purdue University

Motivated by financial applications, continuous-time models driven by Levy processes have been proposed as natural alternatives to the traditional models driven by Brownian Motion. In light of the wide range of competing parametric models, non-parametric methods are important to lessen model biases in the estimation. In this talk, we propose and assess some non-parametric methods for Levy-based models under high-frequency, long horizon, sampling schemes. Two models discussed here are tempered stable processes and time-changed Levy processes with instantaneous rate of time change determined by positive diffusions. The first model is semiparametric, encompassing several of the parametric models in the literature. Two of their appealing features are that their short-term increments are stable-like, while their long-term increments are normal-like. The random-clock in the second class aims at incorporating the volatility clustering, and leverage phenomena exhibited by real financial data.

108 Hitting Times of Brownian Motion and the Matsumoto-Yor Property on Trees

Piotr Witkowski, Faculty of Mathematics and Information Science, Warsaw University of Technology, Poland

Matsumoto-Yor property in bivariate case for real valued random variables reads: if X and Y are independent and follow GIG(-q,a,b) and gamma(q,a) distributions respectively, then the random variables U=1/X-1/(X+Y) and V=1/(X+Y) are also independent and follow gamma(q,b) and GIG(-q,b,a) distributions, respectively. It was proved, by Matsumoto and Yor, through properties of functionals of the geometric Brownian motion and, in the special case q=1/2, using hitting times of Brownian motion.

MY property was later developed by Letac and Wesolowski for univariate and matrix variate variables. Moreover, a multivariate version of this was described, by Massam and Wesolowski, in the language of directed trees and outside of the framework of stochastic processes.

The main object of this talk is to give the interpretation of the MY property on trees for q=1/2 through properties of hitting times of BM, extending the interpretation given in the bivariate case. This is achieved by considering first and last hitting times for a family of BM's defined in terms of the original BM. First we establish a property of BM, which is a multivariate version of the interpretation given by Matsumoto and Yor and then we relate this property to the structure of the trees.

128 Gaussian Process Priors in Nonparametric Bayesian Inference

Harry van Zanten, Department of Mathematics, Vrije Universiteit Amsterdam, Netherlands

We use Gaussian processes as building blocks for the construction of prior distributions on infinite-dimensional models and derive rates of contraction of the corresponding posterior distributions. This rate is shown to depend the position of the true parameter relative to the reproducing kernel Hilbert space of the Gaussian process and the small deviation probabilities of the Gaussian process. We determine these quantities for a range of examples of Gaussian priors and several statistical settings. For instance, we consider the rate of contraction of the posterior distribution based on sampling from a smooth density model when the prior models the log density as a (fractionally integrated) Brownian motion.

This is joint work with Aad van der Vaart.

134 On Weak Solutions of Forward-Backward SDEs

Jin Ma, Department of Mathematics, Purdue University

In this talk we introduce the new notion of Forward-Backward Martingale Problem (FBMP) and study its relation with the weak solution to the forward-backward stochastic differential equations (FBSDEs). The FBMP extends the idea of the well-known (forward) martingale problem of Stroock and Varadhan, but it is structured specifically to fit the nature of an FBSDE. We show that the existence result can be argued relatively easily via the Meyer-Zheng pseudo-path topology. But more importantly, in the Markovian case with bounded and uniformly continuous coefficients, we show that the uniqueness of the solution to the FBMP is determined by the uniqueness of the viscosity solution of the corresponding quasilinear PDE. Some technical constraints imposed in our previous works will be removed.

137 Germ Fields for Harmonizable Symmetric Stable Processes With Rational Spectral Densities

Saeid Rezakhah, Mathematics and Computer Sciences, Amirkabir University of Technology, Iran

A Hilbert space technique to treat continuous time complex-valued strongly harmonizable symmetric stable processes was developed in Nikfar and Soltani (1996), and Soltani and Tarami 2001). In this work we apply the technique to prove that such a process X(t), t real, has a germ field. A germ field is introduced by using the time domain constructed in the cited works. It is also proved that the germ field for such a process with rational spectral density is of finite dimension, generated by certain derivatives of the process at zero, that will be introduced. This work is analogous to that of Hida (1960) in the context of Gaussian processes.

149 Markov Chain Monte Carlo in a Small World

Yongtao Guan, Human Genetics, University of Chicago

We compare convergence rates of Metropolis—Hastings chains to multi-modal target distributions when the proposal distributions can be of "local" and "small world" type. In particular, we show that by adding occasional long-range jumps to a given local proposal distribution, one can turn a chain that is "slowly mixing" (in the complexity of the problem) into a chain that is "rapidly mixing." To do this, we obtain spectral gap estimates via a new state decomposition theorem and apply an isoperimetric inequality for log-concave probability measures. We discuss potential applicability of our result to Metropolis-coupled Markov chain Monte Carlo schemes.

150 Navier-Stokes Equations: Some Stochastic Representations of Solutions in Physical Space

Mina Ossiander, Mathematics, Oregon State University

This talk describes some stochastic representations of mild solutions of the Navier-Stokes equations in three dimensional physical space. In particular these solutions are formulated in terms of conditional expectations of a functional of a semi-Markov branching process. They incorporate both incompressibility and non-linearity while giving existence and uniqueness of solutions on time intervals with length depending on the size of the initial data in certain function spaces.

155 Removing the Exchangeability Condition in Steins Method

Adrian Roellin, Department of Statistics, University of Oxford

Exchangeable pairs have proved to be a valuable tool in Steins method to obtain approximation results for the normal, Poisson and other distributions. It is also considered to be the core of Steins method, where exchangeability and antisymmetric functions play a major role to derive so-called Stein identities. We show by a surprisingly simple argument, how the exchangeability condition can be omitted in many standard settings, requiring only equality in distribution of the involved coupling. As the exchangeable pair is often constructed via an underlying time reversible Markov process, this means that reversibility is no longer required. In the case of approximations by continuous distributions we can even slightly improve the constants appearing in previous results. For Poisson approximation, where a different antisymmetric function is used, additional error terms are needed if the bound is to be extended beyond the exchangeable setting. There is a strong connection between this new approach and the generator interpretation of Stein operators.

189 Skew-Invariant Attracting Solutions for Parabolic Models with Localization

Yuri Bakhtin, School of Mathematics, Georgia Tech

We consider a discrete random media model given by a product-type potential, one factor of which describes the spatial impurities of the environment and the other reflects the random fluctuations in time. We choose the potential so that the associated parabolic system possesses certain localization properties, and for that system we show that it admits a unique global skew-invariant positive solution that serves as a forward and pullback one-point attractor for the system and plays the role of a Perron —Frobenius eigenvector. We also show that due to the localization, the associated random directed polymer model admits a unique infinite-volume Gibbs measure.

190 Reading Policies for Joins: An Asymptotic Analysis

Ralph Russo, Statistics and Actuarial Science, The University of Iowa

Suppose that m_n observations are made from the distribution R and n-m_n from the distribution S. Associate with each pair, x from R and y from S, a non-negative score h(x, y). An optimal reading policy is one that yields a sequence m_n that maximizes E(M(n)), the expected sum of the (n-m_n)m_n observed scores, uniformly in n. The alternating policy, which switches between the two sources, is the optimal non-adaptive policy. In contrast, the greedy policy, which chooses its source to maximize the expected gain on the next step, is shown to be the optimal policy. Asymptotics are provided for the case where the R and S distributions are discrete and h(x, y) = 1 or 0 according as x = y or not (i.e., the observations match). Specifically an invariance result is proved which guarantees that for a wide class of policies, including the alternating and the greedy, the variable

M(n) obeys the same CLT and LIL. A more delicate analysis of the sequence E(M(n)) and the sample paths of M(n), for both alternating and greedy, reveals the slender sense in which the latter policy is asymptotically superior to the former, as well as a sense of equivalence of the two and robustness of the former.

195 Models for Random Union of Discs

Katerina Helisová, Department of Probability and Mathematical Statistics, Charles University in Prague, Czech Republic

This contribution concerns theoretical results for planar random set models which are of principal importance for applications in spatial statistics and stochastic geometry. These models are given by a finite union of discs. Each planar disc is identified with the point in space which has the first two coordinates given by the coordinates of the center of the disc and the third coordinate of the point is equal to the radius of the disc. By this way, the union is identified with the corresponding finite point process. Here the case, when only the union is observed, is considered, because in applications, this situation frequently occurs. The corresponding point process is then specified by density with respect to Poisson point process and this density is of exponential family form with the canonical sufficient statistic depending on the corresponding point process only through the union, so that the statistic is specified by geometric characteristics of the union, e.g. its area, the length of its boundary etc.

The main tool for deriving the results is the power tessellation, which provides a subdivision of the union useful for studying stability properties of the distribution of the corresponding point process and of MCMC algorithm for simulating it, when making computations of various geometric characteristics.

197 Two Applications of Large Deviations to Randomly Perturbed Nonlinear Dispersive Waves

Eric Gautier, Cowles Foundation, Yale University

We present applications of sample path large deviations for two stochastic nonlinear dispersive wave equations. The deterministic models are the nonlinear Schrodinger and Korteweg-de Vries equations and share the property that solitary waves solutions may exist.

Stochastic nonlinear Schrodinger equations are for example models in soliton based communication systems where noise is induced by the amplification devices used to counterbalance for loss. Two processes are mainly responsible for error in soliton transmission. They are the fluctuation of the energy and arrival time of the pulse. Qualitative behavior in the parameters of these processes in the small noise asymptotic are obtained without relying on collective coordinate approximation.

The second application is related to the stochastic Korteweg-de Vries equation which appear for example to describe waves on shallow water surfaces. We characterize and compare the qualitative behavior of the exit times from a neighborhood of the soliton and randomly modulated soliton and obtain their order in the amplitude of the noise.

These are joint works with respectively Arnaud Debussche and Anne de Bouard.

202 Decision Making with Partially Observable Poisson Processes

Michael Ludkovski, Mathematics, University of Michigan

We study decision making problems on finite horizon with Poissonian information arrivals. In our model, a decision maker wishes to optimally time her action under an unobservable Markovian environment. Information about the environment is collected through a (compound) Poisson observation process. Examples of such systems arise in investment timing, reliability theory, Bayesian regime detection and technology adoption models. Using piecewise-deterministic process theory we completely solve the problem and describe how to calculate its value function and optimal stopping rule. This nests many previous results without any restrictions on model parameters. Our method lends itself to simple numerical implementation and we present several illustrative examples. (joint work with S.O. Sezer, U of Michigan)

249 Local Times of Multifractional Brownian Sheets

Dongsheng Wu, Mathematical Sciences, University of Alabama in Huntsville

Under some regularity conditions on the Hurst functionals, we prove the existence, joint continuity, and the H\"{o}lder regularity of the local times for multifractional Brownian sheets. We also determine the local Hausdorff dimensions of the level sets of multifractional Brownian sheets. Our results extend the results of Ayache and Xiao (2005) and Ayache, Wu and Xiao (2006) for fractional Brownian sheets and Boufoussi, Dozzi and Guerbaz (2006a, b) for multifractional Brownian motion to multifractional Brownian sheets.

257 Maximum Likelihood Estimator for Stochastic Differential Equations Driven by Fractional Brownian Motion

Frederi Viens, Statistics, Purdue University

We consider a nonlinear stochastic differential equation with additive fractional Brownian noise, with known Hurst parameter between 0 and 1, and investigate the estimation of a multiplicative scale parameter in front of the non-linear drift function. Using stochastic analytic techniques including the Malliavin calculus, we show that the maximum likelihood estimator for the scale parameter is strongly consistent as time increases. We also show that a discretized version of this estimator, based only on observations of the equations solution at discrete and evenly distributed times, is strongly consistent as the number of observations tends to infinity. The proofs are different, depending on whether the Hurst parameter is greater or smaller than 1/2. This is joint work with Prof. Ciprian Tudor.

This talk to be presented at SPA 07 in the special session organized by Hans-Juergen Engelbert and Jin Ma.

261 Relativistic Stable Process in a Halfspace

Michal Ryznar, Department of Mathematics and Informatics, Wroclaw University of Technology, Poland

The purpose the talk is to present recent results concerning the potential theory of the relativistic alpha stable process. Its potential theory for open bounded sets has been well developed throughout the recent year however almost nothing was known about the behaviour of the process on unbounded sets even in the case of such regular sets as halfspaces. In the talk sharp and optimal estimates for the Green function of a halfspace will be presented. Also some results concernig Green functions of bounded sets will be described.

Our approach combines the recent results obtained by Byczkowski, Malecki and Ryznar, where an explicit integral formula for the m resolvent of a half-space was found (m is the parameter of the process), with estimates of the transition densities for the killed process on exiting a half-space.

The main result states that the Green function is comparable with the Green function for the Brownian motion if the points are away from the boundary of a halfspace and their distance is more than one. For the remaining points the behaviour is a mixture of the isotropic stable and Brownian case and also depends on the dimension of the underlying space.

262 A Waiting Time Problem Arising from the Study of Multi-Stage Carcinogenesis

Jason Schweinsberg, Mathematics, University of California, San Diego

We consider the following population genetics problem: How long does it take before some member of a population of fixed size N accumulates m mutations? This problem is relevant to the onset of cancer because cancer is often the result of several mutations. This talk is based on joint work with Rick Durrett and Deena Schmidt.

278 Adapted Solutions to the Backward 2D Stochastic Navier-Stokes Equations

Padmanabhan Sundar, Mathematics, Louisiana State University

The backward two-dimensional stochastic Navier-Stokes equations (BSNSEs, for short) corresponding to incompressible fluid flow in a bounded domain will be discussed. Suitable a priori estimates for adapted solutions of the BSNSEs are obtained which reveal a surprising pathwise bound on the solutions. The existence of solutions is shown by using a monotonicity argument. Uniqueness is proved by using finite-dimensional projections, linearization and truncation. The continuity of the adapted solutions with respect to the terminal data and the external body force is also established. This is a joint work with Hong Yin.

279 Boundary Harnack Inequality for Subordinate Brownian Motions

Renming Song, Mathematics, University of Illinois at Urbana-Champaign

In this talk I will present some recent results on the potential theory of subordinate Brownian motions. We will show that, for a large class of subordinate Brownian motions, the boundary Harnack inequality is valid. The results presented here are generalizations of earlier results for symmetric stable processes by Bogdan (97) and Song-Wu (99), and earlier results for relativistic stable processes by Ryznar (02) and Chen-Song (03). The results of this talk are based on joint work with Panki Kim and Zoran Vondracek.

282 Mutual Information and Estimation Error on Wiener Space

Eddy Mayer-Wolf, Mathematics, Technion, Israel Institute of Technology

We consider the abstract problem of estimating a signal from its noisy linear observation, the noise being modeled by an abstract Wiener space W. Relations are obtained connecting the causal and noncausal estimation errors with the mutual information between both signals. In particular, the causal estimation error turns out not to depend on the chosen time structure (which is determined by any resolution of the identity on Ws Cameron-Martin space). As an application, the Yovits-Jackson formula is rigorously derived for the causal estimation error of a multivariate stationary Gaussian process.

This is joint work with Moshe Zakai.

292 An Agent Based Stock Price Model

Zeynep Akcay, Mathematics, Koc University, Turkey

Fractional Brownian motion (fBm) has recently been considered as a model for stock prices. It is known to allow for arbitrage and explicit arbitrage strategies have been constructed. Stock price models which are free of arbitrage opportunities and approximate fBm or integrals with respect to fBm in the limit are also studied. Agent based modeling is widely used to find a model that best fits stock price processes. Sometimes, the agents are divided into groups that have different demand functions for the stock. The price is generally determined via the total excess demand.

We consider an agent based stochastic model of a stock price. Agents can belong to different groups such as chartists and fundamentalists. Under the assumption of positive correlation between the total net demand and the price change, we assume that a buy order increases the price whereas a sell order decreases it. Each order has an effect proportional to its quantity. This effect starts when the order is given, increases to a maximum which is proportional to the total order amount, and then starts decreasing until it vanishes after a finite amount of time.

The logarithm of the stock price is found by aggregating the effects of orders placed by the agents. The arrival time, quantity and the duration of an order are all governed by a Poisson random measure. The duration of the effect of an agent's transaction is assumed to follow a heavy tailed distribution. We consider the limiting price process as the number of order arrivals increases and the quantity of the orders decreases. We show that the price process is long-range dependent and fBm is obtained in the limit. As a semi-martingale, our process does not allow for arbitrage. It is a novel model which is alternative to existing agent based constructions that are semi-Markov processes.

303 Brownian Chen Series and Atiyah-Singer Index Theorem

Fabrice Baudoin, Institute of Mathematics, University Paul Sabatier, France

The purpose of this work is to use the representation of heat semigroups as the expectation of an infinite Lie series in order to give a new short proof of Atiyah-Singer local index theorem.

310 Attraction Time for Strongly Reinforced Walk

Codina Cotar, Mathematics, Technische Universität Berlin, Germany

We consider a class of strongly edge reinforced random walks, where it is known that almost surely an attracting edge appears eventually whenever the underlying graph is locally bounded. This means that starting from some finite random time T the particle traverses one and the same edge, with probability 1.

We study the asymptotic behavior of the tail distribution of the (random) time T of attraction.

It turns out that there is a universality type property: for a given strong weight reinforcement W, the tails of T corresponding to the walk on the 2-edge graph are of the same order of magnitude as those corresponding to the walk on any finite graph. Some partial results are obtained for infinite trees and general locally finite graphs. This is joint work with Vlada Limic.

318 Ergodicity Conditions in Star Queueing Networks

Kandouci Abdeldjebbar, Mathematics, Saida University in Algeria

the goal of this article is the study of a particular stochastic queueing network called star network , it is a telecommunications network having for objective the management and the transmission of the data between the various users located around a network of the symmetrical star type. Our goal is to seek the sufficient and necessary conditions of ergodicity of the main Markov process by using the Lyapunov functions.

323 Stationary Solutions of Stochastic Delay Differential Equations Driven by Levy Noise

Onno van Gaans, Mathematical Institute, Leiden University, Netherlands

We consider a stochastic delay differential equation driven by a Levy process. Both the drift and the noise term may depend on the past. The drift is assumed to be linear and exponentially stable. The coefficient of the noise should be Lipschitz and bounded. If the Levy process does not have too many too big jumps, then there exists a stationary solution. For a proof, we consider segments of a solution as a process in the Skorokhod space of cadlag functions. We show that the segment process is eventually Feller and we show that it has uniformly tight distributions. The proof of the tightness uses semimartingale characteristics.

336 Remarks on Nonlocal Operators with Variable Order

Toshihiro Uemura, Department of Mathematics, University of Connecticut (and School of Business Administration, University of Hyogo, Japan)

For a given kernel n(x,y) on R^d, consider a (Levy-type) nonlocal operator Lf(x) having n(x,y) as a Levy-kernel and a symmetric jump type quadratic form E(f,g) defined by n(x,y).

In this talk, we reveal a connection between Lf(x) and E(f,g) under some condition for n(x,y). In fact, under a mild assumption for the kernel n(x,y), we can show that the quadratic form E(f,g) is obtained by integrating the carré du champ operator Gamma(f,g)(x) relative to L. Then, we can always construct a symmetric Hunt process corresponding to the form E, even when the generator L does not produce a stochastic process.

We also consider a connection between the (L^2)-generator of E(f,g) and L. In the last, we will examine the results to the case of "stable-like processes."

340 Nonlinear Filtering of Random Fields in the Presence of Long Memory Noise

Matthew Linn, Statistics, University of Michigan

This work is devoted to the development of multi-parameter non-linear filtering theory in the case when the observation noise lacks a semimartingale structure and has long memory. Specifically, we consider a nonlinear filtering problem in the case when the underlying signal is a multi-parameter semimartingale random field and the observation noise is given by a persistent fractional Brownian sheet. We derive several stochastic evolution equations for the optimal filter and show that unlike the classical case, the latter equations fail to be "proper" stochastic measure-valued partial differential equations due to the effects of long-memory in the observation noise. If time permits, several approximations to the optimal filter in terms of multiple integral expansions will also be presented. This talk is based on joint work with Anna Amirdjanova.

343 Asymptotics of Bivariate Generating Functions: Airy Function Local Limits

Manuel Lladser, Applied Mathematics, The University of Colorado

We consider bivariate generating functions of the form $F(z,w):=\sum f_{r,s} z^r w^s$ which are of a meromorphic type (i.e. ratio of analytic functions) around the origin. Here the coefficients $f_{r,s}$ are complex numbers indexed by nonnegative integers r and s. Generating functions of this form occur frequently in the analysis of discrete random structures. For instance, $f_{r,s}$ could represent (i) the probability that a certain random path in the two-dimensional integer lattice eventually visits the point (r,s), or (ii) the probability that a certain finite set of binary patterns occur r-times in a random binary string of length s, or (iii) the probability that the diameter of a random Cayley digraph of order r and degree s exceeds 2. We provide uniform asymptotic formulae for the coefficients $f_{r,s}$ along cones of directions in the (r,s)-lattice determined by regular points of the singular variety of $F(z,w)$. While in most situations these asymptotic formulae are of an exponential-quadratic type (i.e. local limits related to Gaussian distribution) we show that near certain ``degenerate directions they are of an exponential-cubic type (i.e. local limits related to an Airy function), and more generally of an exponential-polynomial type.

349 Derivatives of an Asian Call Price

Kyounghee Kim, Mathematics, Florida State University

Using changing of measure method, an European style Asian call price can be expressed by an expected value of a function of a time integral of geometric brownian motion. Its derivatives (such as delta, gamma, etc) can also be written in terms of an expected value of functions of geometric brownian motion. We discuss the specific measure we used to obtain the integral form solution and show the explicit forms of derivatives at time $t=0$.

354 Limiting Distributions in Polya and Ehrenfest Processes

Srinivasan Balaji, Statistics, George Washington University

In this talk we will discuss results on Polya and Ehrenfest processes. Polya process is obtained by embedding a discrete Polya urn process in continuous time. Polya processes give us the best heuristics to approximate and understand the intricate Polya urn models as the discrete proces is in general difficult to deal with. Our recent work has shown that a class of partial differential equations, related to the corresponding ball addition matrix, governs such processes. However only in some cases these partial differential equations are amenable to asymptotic solution. By using the method of moments we obtain the limiting distribution via matrix formulation that involve Leonard pairs.

After describing the general Polya process, we will restrict our attention to a tenable class of urns that generalize the classical Ehrenfest model. Ehrenfest urns arise in applications to model the exchange of particles in two connected gas chambers. In this case we show that the limiting distribution is binomial, whose number of trials is an integer invariant property of the process. Finally we conclude with some remarks on the connections to pseudo expectation of Markov chains and some future research.

355 One-Dimensional Stochastic Differential Equations with Singular Drift

Jochen Wolf, University of Applied Sciences, Koblenz, Germany

We introduce a class of one-dimensional stochastic differential equations whose drift term is represented by an integral with respect to local time. We derive necessary and sufficient conditions for existence and uniqueness in law.

362 A Degenerate Variance Control Problem with Discretionary Stopping

Ananda Weerasinghe, Math, Iowa State University

We consider an infinite horizon stochastic control problem with discretionary stopping. The state process is given by a one-dimensional stochastic differential equation. The diffusion coefficient is chosen by an adaptive choice of the controller and it is allowed to take the value zero. The controller also chooses the quitting time to stop the system. Here, we develop a martingale characterization of the value function and use it together with the principle of smooth-fit to derive an optimal strategy when the drift coefficient of the state process is linear.(Joint work with Daniel Ocone, Rutgers University.)

375 Brownian Motion and Geometric Inequalities

Huiling Le, School of Mathematical Sciences, University of Nottingham, United Kingdom

In recent years, there has been much work generalising the classical Brunn-Minkowski inequality for the volumes of three related convex sets in Euclidean space to more general functionals. Among those are the inequalities for the solutions of the heat equation and for the first eigenvalues of the Laplacian. In this talk, we discuss the role of Brownian motion played in obtaining these results as well as in recent progress in the generalisation of these results to manifolds.

377 Singular Stochastic Differential Equations

Alexander Cherny, Department of Probability Theory, Moscow State University, Russian Federation

We consider one-dimensional homogeneous stochastic differential equations. It is well known that a certain integrability condition (due to H.-J. Engelbert and W. Schmidt) implies local regular behaviour of the solutions. Left unexplored was the question of what happens at points where this condition fails: does a solution exist; is it unique; are these points accessible; penetrable? and so on.

We introduce a class of points termed isolated singular points. Stochastic differential equations possessing such points (these are termed singular SDEs) often arise in theory and in applications.

The talk will deal with the problems of the existence, the uniqueness, and, what is most important, on the qualitative behaviour of solutions of singular SDEs. This is done by providing a qualitative classification of isolated singular points, according to which such a point can have one of 48 possible types.

The talk is based on a joint monograph with Hans-Juergen Engelbert "Singular Stochastic Differential Equations", Lecture Notes in Mathematics, 1858 (2004).

392 Stochastic Epidemic Model with Vaccination

Jakub Stanek, Department of Probability and Mathematical Statistics, Charles University in Prague, Czech Republic

Our contribution concerns a stochastic model designed to describe a possible time dynamics of an infection. We have chosen the classical Kermack-McKendrick differential equation for its deterministic part, added a natural diffusion component and devised a time dependent vaccination control of the infection. The model is governed by stochastic differential equation (SDE), where the time dynamics of the suspectibles, infectives and removals subpopulation is described.

We present some conditions on the existence of a solution to the nonlinear SDE and discuss in detail the technical problems delivered by the form of the model. Finally, we suggest a modification which offers stronger theoretical results while its interpretation and applicability is saved.

Some simulations and relevant numerical illustration are to be shown.

395 Boundary Behavior of Harmonic Functions for Truncated Stable Processes

Panki Kim, Department of Mathematics, Seoul National University, Korea

Recently there has been a lot of interest in studying discontinuous stable processes due to their importance in theory as well as applications. Many deep results have been established. However in a lot of applications one needs to use discontinuous Markov processes which are not stable processes. For example, in mathematical finance, it has been observed that even though discontinuous stable processes provide better representations of financial data than Gaussian processes financial data tend to become more Gaussian over a longer time-scale. The so called tempered stable processes have this required property: they behave like discontinuous stable processes in small scale and behave like Brownian motion in large scale. These processes are obtained by ``tempering stable processes, that is, by multiplying the Levy densities of stable processes with strictly positive and completely monotone decreasing factors. However, no matter how much we temper the stable process, it still can make any size of jumps with positive probability.

In this talk, we considered an extreme case of tempering: we truncated the Levy densities of stable processes and obtained a class of Levy processes called truncated stable processes. Levy density coincides with the Levy density of a symmetric stable process for small $|x|$ and is equal to zero for large $|x|$. Truncated stable processes are very natural and important in applications where only jumps up to a certain size are allowed. Jointly with Renming Song we have studied the potential theory of truncated symmetric stable processes. Among other things, we proved that the boundary Harnack principle is valid for the positive harmonic functions of this process in any bounded convex domain and showed that the Martin boundary of any bounded convex domain with respect to this process is the same as the Euclidean boundary. However, for truncated symmetric stable processes, the boundary Harnack principle is not valid in non-convex domains.

In this talk, we show that, for a large class of not necessarily convex bounded open sets, the Martin boundary with respect to any truncated symmetric stable process is still the same as the Euclidean boundary. For truncated symmetric stable processes, relative Fatou type theorem is also true in those open sets.

This is a joint work with Renming Song.

399 On Weak Solutions of Backward Stochastic Differential Equations

Hans-Jürgen Engelbert, Faculty of Mathematics and Informatics, Institute for Stochastics, Jena, Germany

This talk is based on joint work with R.-Buckdahn (Brest, France) and A.-Rascanu (Iasi, Romania). The main objective consists in introducing and discussing the concept of weak solutions of certain backward stochastic differential equations (BSDEs).

Using weak convergence in the Meyer-Zheng topology, we shall give a general result on the existence of a weak solution, with driving process admitting a given distribution, defined on some filtered probability space. A further main problem we deal with is the possibility of the existence of discontinuous solutions. There is a close connection between continuity of all solutions, uniqueness in law and pathwise uniqueness of the solution. In particular, pathwise uniqueness holds whenever every weak solution of the BSDE has a.s. continuous paths, and this condition is even necessary if the driving process is a continuous local martingale satisfying the previsible representation property.

413 Almost Sure Functional Central Limit Theorem for Ballistic Random Walk in Random Environment

Timo Seppalainen, Mathematics, University of Wisconsin, Madison

A functional central limit theorem under almost every environment is proved for multidimensional random walk in a product random environment. The assumptions are transience in some definite spatial direction and high enough moments on the regeneration time. The main point behind the result is that the quenched mean of the walk behaves subdiffusively.

Joint work with Firas Rassoul-Agha.

415 Upper Tails for Intersection Local Times of Random Walks in Supercritical Dimensions

Xia Chen, Department of Mathematics, University of Tennessee

We determine the precise asymptotics of the logarithmic upper tail probability of the total intersection local time of p independent random walks in $\Z^d$ under the assumption $p(d-2)>d$.

Our approach allows a direct treatment of the infinite time horizon.

420 Flows through Random Networks: Probabilistic and Statistical Problems

Shankar Bhamidi, Statistics, University of California, Berkeley

In the last few years with the availability of large amounts of data, there has been a lot of effort in coming up with Network models trying to explain "Real world" networks as well as in trying to model dynamic processes on these networks. In connection to the above consider the following two problems:

1. Edge flow problem: Given a connected network with edge costs, suppose each node sends a unit amount of flow to every other node via the least cost path. We are interested in the amount of flow passing through various nodes and edges. What happens when the Network becomes large? Can we come up with a tractable math model giving us precise asymptotic information? Using continuous time branching processes and "local information" of the neighborhood about edges we show how this can be done.

2 .Multicast tree problem: In a number of problems that arise from trying to discover the underlying structure of the Internet, often it is impossible to take direct measurements at the routers. We shall mention some initial progress in trying to reconstruct the "Multicast" tree using only "end- to-end" measurements. Using ideas from algorithms in phylogenetics (reconstructing the "tree of life") we show how this can be done efficiently.

422 Three Easy Pieces on Levy Processes

Rene Schilling, Mathematics, Universität Marburg, Germany

We discuss three topics on Levy Processes: recurrence/transience, exact dimension results and p-variation. Although these are classical topics we will give some short new proofs.

423 A Local Time Correspondence for the Linear Stochastic Heat Equation

Mohammud Foondun, Mathematics, University of Utah

We consider a class of linear stochastic heat equations driven by space time white noise. More precisely, we look at the heat equation with respect to some operator L, together with an additive white noise. We give necessary and sufficient conditions for the existence of function-valued solutions. The novelty here is that these conditions are phrased in terms of the local times of X, where X is the levy process associated with the operator L. We also give continuity results for the solutions of the s.p.d.e in terms of the local times. Finally, we look at the case when the operator L is the generator of a Markov process and give necessary and sufficient conditions for the existence of function-valued solutions. Here the conditions are in terms of the resolvent density of the process. Some examples are also given. This talk is based on joint work with D. Khoshnevisan and E. Nualart.

424 Semimartingale Properties of Stochastic Convolutions

Igor Stojkovic, Mathematical Institute, Leiden University, Netherlands

We consider stochastic convolution integrals with respect to a semimartingale Z, of a deterministic function g defined on positive real axis, having finite variation on compacts. That is, a stochastic integral from 0 to t of g(t-s)dZ_s. These random variables are at all times only almost surely determined, and we want to research when is it possible to pick versions such that the obtained process is a semimartingale. Processes of this type appear in the variation of constants formula for a stochastic delay differential equation.

One of the results is that for any semimartingale the stochastic convolution integral has a semimartingale version, if the deterministic function is locally absolutely continuous with locally square integrable derivative. In case of Brownian motion as integrating semimartingale, the local square integrability of the derivative is necessary as well, for locally absolutely continuous functions. Another result is that for continuous functions if there is a semimartingale version, then it is a process of locally finite variation.

437 Space-Time Homogenization of Stochastic Hamilton-Jacobi-Bellman Equations

Elena Kosygina, Mathematics, Baruch College and the CUNY Graduate Center

We consider a family of solutions of the final value problem for a Hamilton-Jacobi-Bellman equation with a random Hamiltonian and a vanishing viscous term. The time-space dependence of the Hamiltonian is realized through the shifts in a stationary ergodic random medium. For Hamiltonians, which are convex in the momenta variables and satisfy certain growth and regularity conditions, we show the almost sure locally uniform in time and space convergence of the family of solutions to the solution of a final value problem for a deterministic ``effective first order Hamilton-Jacobi equation. The averaged Hamiltonian is given by a variational formula. This is a joint work with S.R.S. Varadhan.

460 Approximation of Jump Processes on Fractals

Michael Hinz, Math. Institut, University of Jena, Germany

We consider Markov pure jump processes on fractal stes in Euclidean space. These processes have been studied by several authors in a number of recent works. First we investigate processes on general d-sets, usually of zero Lebesgue measure. Approximations by jump processes on closed sets of positive Lebesgue measure decreasing to the fractal are provided. To this purpose the Mosco convergence of the associated Dirichlet forms is proved. It implies the convergence of the spectral structures and in particular the weak convergence of the finite dimensional distributions. Our main idea is to use some suitable spatial averaging.

Additional results are obtained for nice classes of self-similar sets, which also allow approximations in terms of finite Markov chains. The methods and results are similar to the general case.

461 The Set-Indexed Fractional Brownian Motion along Increasing Paths

Erick Herbin, Dassault Aviation, France

The set-indexed fractional Brownian motion (sifBm) has been defined by E. Herbin and E. Merzbach in 2006, for indices in a collection of compact subsets of a locally compact metric space equipped with a Radon measure. Its properties of stationarity and self-similarity have been discussed. In particular, it has been proved that the projection of a sifBm on an increasing path is a one-parameter time changed fractional motion. In this talk, we show the converse.

If X is a L^2-monotone outer-continuous set-indexed process such that its projection X^f on any elementary flow f is a time-changed one-parameter fractional Brownian motion, then X is a set-indexed fractional Brownian motion.

467 Optimal Buffer Size and Dynamic Rate Control for a Queueing Network with Reneging in Heavy Traffic

Arka Ghosh, Statistics, Iowa State University

We address a rate control problem associated with a single server finite-buffer Markovian queueing system with customer abandonment in heavy traffic. The controller can choose and fix a buffer size of the queue and can dynamically control the arrival and/or the service rates depending on the current state of the network. We consider the infinite horizon discounted cost criterion, where the cost function includes a penalty for each rejected customers, a control cost related to the adjustment of the arrival and service rates as well as a penalty for each abandoned customer. Here we obtain an explicit solution of the approximating diffusion control problem (Brownian control problem or BCP) and using this solution, construct controls for the queueing network control problem. We also prove asymptotic optimality of this policy, using generalized regulator maps (Skorohod maps) and weak convergence techniques. In addition, we identify the parameter regimes where infinite buffer size is optimal.

469 Asymptotics for Restriction Measures in Thin Annuli

Robert Bauer, Mathematics, University of Illinois at Urbana-Champaign

We use conformal maps to obtain explicit upper and lower bounds for the probability that a chordal restriction measure in the unit disk does not enter the disk of radius 1-r, and then find the exponential rate at which this probability decays to zero as r tends to 0.

476 Superfast Coupling and Rapid Mixing

Yevgeniy Kovchegov, Mathematics, Oregon State University

We will discuss recent developements in coupling methods and mixing times. We will go through some of the new, often non-Markovian approaches to coupling and applications, showing rapid mixing. This presentation is based on joint work with R.Burton.

485 Structure of the Virasoro Algebra and Ricci Curvature of the Kirillov Space

Paul Lescot, INSSET, Université de Picardie, France

Kirillovs construction provides a canonical identification between the homogeneous space Diff(S1)/Rot(S1) and a certain space of univalent functions on the unit disk. This space carries a canonical Kâhlerian structure, and the associated Ricci curvature tensor has been determined in our joint work with M. Gordina (JFA, 2006). We shall try to clarify the computations involved in these constructions; it turns out that they are intimately related to purely algebraic properties of the Virasoro algebra, the essentially unique central extension of the Lie algebra diff(S1) of Diff(S1).

490 The Two-Parameter Ewens Distribution: A Finitary Approach

Paolo Viarengo, Aerospatial Engineering, University of Naples "Federico II," Italy

The new approaches to macroeconomic modelling that describe macroscopic variables in terms of the behaviour of a large collection of microeconomic entities, has often dealing with the problem of clustering of agents in the market. Aoki and Yoshikawa define "cluster" any group of economic agents (a sector, an industry…) with the same choice or same set of attributes. What Dynamics emerges in the processes of formation and dissolution of clusters comprising interacting agents?

Clustering has often been described by Ewens Sampling Formula (ESF) which has been generalized recently by Pitman to two parameter, where the "weight" for the mutation probability depends on the number of existing clusters. In contrast with the usual complex derivations, we suggest a finitary characterization of the two-parameter ESF pointing to real economic processes. We derive some essential feature of the model without introducing notions like frequency spectrum, structure distribution or size-biased permutation invariance, that are difficult to apply to concrete finite populations. Our approach is finitary in the sense that we provide a probabilistic description of a system of n individuals considered as a closed system, a population, where individuals can change attributes over time. We suppose that the choice is probabilistic, the resulting accommodation probability being a generalization of the famous Ehrenfest-urn-scheme, with the great difference that the creation term is influenced by the results of all previous choices (Ehrenfest-Pitman scheme). The equilibrium probability is understood as the fraction of time the system spends in the considered partition. A finite model of economic interacting agents whose equilibrium aggregation state is described by the two-parameter Ewens distribution is presented. The exact marginal description of a site is derived, wherefrom birth, life and death of clusters is easy to extract.

512 Symmetrization of Levy Processes

Pedro Mendez, Mathematics, Universidad de Costa Rica

The purpose of this paper is to show that many of the isoperimetric —type results which have been well known for many years for the Laplacian and Brownian motion hold for very general Levy processes. In particular we will show generalizations of the Faber-Krahn theorem on eigenvalues, isoperimetric inequalities for heat kernels, Green functions, and exit times for Brownian motion.

517 Motion in a Random Force Field

Leonid Koralov, Department of Mathematics, University of Maryland

We consider the motion of a particle in a random isotropic force field. Assuming that the force field arises from a Poisson field in R^d, d >3, and the initial velocity of the particle is sufficiently large, we describe the asymptotic behavior of the particle.

520 Resonance in the Scalar Transport Equation under Periodic Shear-Flow and Boundary Noise

Vena Pearl Bongolan, Ellis College, New York Institute of Technology (Cardean Learning Group, Chicago); Jinqiao Duan and George Skountrianos, Department of Applied Mathematics, Illinois Institute of Technology, Chicago

The time and space-averaged salinity of a gravity current evolving under an assumed sinusoidal shear-flow with noise in the boundary was previously observed to have high-amplitude oscillations for high-frequency shear-flows, regardless of the noise, with or without noise. The finding in this extended study is that it happens even for low-frequency shear flows, and various frequencies are being studied. These oscillations attain several relative maxima when plotted against the frequency, suggesting resonance. Specifically, decaying oscillations are observed. The most intriguing result is that, for currents evolving under colored Levy noise, the oscillations initially decay to a small, constant rate, then increase again.

Experiments on varying the variance of the noise (interpreted as its strength) are also being carried out. Levy colored noise is affected most by the increasing the variance, and it has the effect of hastening the initial damping observed above.

A new metric to measure the effect of boundary noise is also being developed. Preliminary results show that Wiener white and colored and Levy white noises all have the effect of a causing a linear increase in the averaged salinity, but Levy colored noise gives an initial increase in the salinity, followed by a continuous decrease.

525 A Strictly Stationary, 5-tuplewise Independent Counterexample to the Central Limit Theorem

Richard Bradley, Mathematics, Indiana University

A strictly stationary sequence of random variables is constructed with the following properties: The random variables each take just the values -1 and +1, with probability 1/2 each; every five of the random variables are independent; and for every infinite set Q of positive integers, there exists an infinite subset T of Q and a nondegenerate, nonnormal probability measure m on the real line (m may depend on Q) such that the n-th partial sum divided by the square root of n converges in distribution to m as n increases in T. This example complements the strictly stationary, pairwise independent counterexamples (to the central limit theorem) constructed by Janson [Stochastics 23 (1988) 439-448]; the strictly stationary, three-state, absolutely regular, triplewise independent counterexample developed in two papers by the author [Probab. Th. Rel. Fields 81 (1989) 1-10, Rocky Mountain J. Math. (in press)]; and also the N-tuplewise independent, identically distributed (but not strictly stationary) counterexamples constructed by Pruss [Probab. Th. Rel. Fields 111 (1998) 323-332] for arbitrary positive integers N.

542 On Martingale Approximations

Michael Woodroofe, Statistics, University of Michigan

Necessary and sufficient conditions for the existence of a martingale approximation to an additive functional of a Markov chain are developed. In the first, a norm is defined and intuitive necessary and sufficient conditions are obtained in terms of this norm. The result is illustrated by considering chains whose transition function is a normal operator. In the second main result, a convenient orthonormal basis is defined for the space of square integrable functions with respect to the stationary (marginal) distribution, and it is shown how this leads to a simple necessary and sufficient condition.

568 Estimates and Structure of Harmonic Functions of Fractional Laplacian

Krzysztof Bogdan, Mathematics/ Statistics, WUT/Purdue University

This is a joint work with Tadeusz Kulczycki and Mateusz Kwasnicki.

We prove a uniform boundary Harnack inequality for nonnegative harmonic functions of the fractional Laplacian on arbitrary open set D. This yields a unique representation of such functions as integrals against measures on the complement of D augmented by the point at infinity. The corresponding Martin boundary of D is a subset of the Euclidean boundary determined by an integral test.

576 Estimation of Characteristics of Stationary Poisson Segment Process

Zbynek Pawlas, Department of Probability and Mathematical Statistics, Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic

Stochastic geometry deals with random processes of geometrical objects. One of the basic example is a point process of line segments. The data are formed by the realization of the process within a bounded sampling window. Usually the segments which hit the boundary of the window are not completely observable and so called edge effects arise. Our aim is to study the estimation of several parameters of the process.

One of the basic characteristics of segment processes is the length intensity which is defined as mean length of segments observed in the window of unit volume. For the case of stationary Poisson process of segments it is possible to compare three different estimators of length intensity by calculating the variances exactly. Further, we consider the estimation of intersection intensity, i.e. mean number of intersections in the unit volume window. The estimation of length distribution is also discussed. Moreover, we investigate asymptotic behaviour of the estimators as the window expands without bound.

587 The Yamada-Watanabe-Engelbert Theorem for General Stochastic Equations

Thomas G. Kurtz, Mathematics and Statistics, University of Wisconsin, Madison

In the study of stochastic equations, it is common to distinguish between "strong" solutions and "weak" or distributional solutions. Roughly, a strong solution is one that exists for a given probability space and given stochastic inputs while existence of a weak solution simply ensures that a solution exists on some probability space for some stochastic inputs having the specified distributional properties. Similarly, strong uniqueness asserts that two solutions on the same probability space with the same stochastic inputs agree almost surely while weak uniqueness asserts that two solutions agree in distribution.

For Ito equations, Yamada and Watanabe (1971) proved that weak existence and strong uniqueness imply strong existence and weak uniqueness. Engelbert (1991} extended this result to a somewhat more general class of equations and gave a converse in which the roles of existence and uniqueness are reversed, that is, strong existence and weak uniqueness, in the sense that the joint distribution of the solution and the stochastic inputs is uniquely determined, imply strong uniqueness.

The issues addressed in these results arise naturally for any stochastic equation and extensions to other settings occur frequently in the literature. The talk will give general results that cover all the cases in the literature, known to the speaker, as well as other settings in which these questions have not yet been addressed.

590 On a Stochastic Shell Model

Hakima Bessaih, Mathematics, University of Wyoming

Some stochastics shell models related to fluids will be studied. Some results about existence of invariant measures and stochastic attractor will be given. If time permitted, some remarks on p-structure functions will be discussed.

609 Almost-Sure Eyapunov Exponent for a Directed Polymer in a Fractional Brownian Environment

Frederi Viens, Statistics, Purdue University

We consider a directed polymer on the unit circle, with a continuous direction (time) parameter t, defined as a simple random walk subjected via a Gibbs measure to a Hamiltonian whose increments in time have either long memory (Hurst parameter H between 1/2 and 1) or semi-long memory (H between 0 and 1/2), and which also depends on a space parameter (position/state of the polymer). H is interpreted as the Hurst parameter of an infinite-dimensional fractional Brownian motion. The partition function u of this polymer is linked to stochastic PDEs via a long-memory parabolic Anderson model. We present a summary of the new techniques which are required to prove that, in the semi-long memory case, the almost sure Lyapunov exponent of u exists and is non-random, and in the long-memory case, it is infinity, while the correct exponential growth function in that case is sandwiched between t^{2H} / log t and t^{2H} (instead of being equal to t, as in the semi-long memory case). These tools include an almost sub-additivity concept, usage of Malliavin derivatives for concentration estimates, and an adaptation to the long-memory case of some arguments from the case H=1/2 (no memory), which require a detailed study of the interaction between the long memory, the spatial covariance, and the simple random walk. This talk describes joint work with Dr. Tao Zhang.

This talk to be presented at SPA 07 in the special session organized by Davar Khoshnevisan and Yimin Xiao.

611 Measurability of Optimal Transportation and Convergence Rate for Landau Type Interacting Particle Systems

Joaquin Fontbona, Mathematical Engineering, University of Chile

We consider nonlinear diffusion processes driven by space-time white noises associated with the Landau equation arising in kinetic theory. Our goal is to prove the convergence of an easily simulable diffusive interacting particle system, towards this nonlinear process (propagation of chaos) and to obtain an explicit pathwise rate. To do this, we introduce a new type of coupling between finitely many Brownian motions and the infinite dimensional white noise process. The key idea is to construct the right Brownian motions by pushing forward the white noise processes, through the Brenier map realizing the optimal transport between the law of the nonlinear process, and the empirical measure of independent copies of it. A striking problem then is to establish the joint measurability of this optimal transport map with respect to the space variable and the parameters (time and randomness) making the marginals vary. We obtain a general measurability result for the mass transportation problem in terms of the support of the transfert plans, in the sense of set-valued mappings. This allows us to construct the coupling and prove explicit convergence rates.

This is a joint work with Hél ne Guérin (U. Rennes I, France) and Sylvie Méléard (Ecole Polytechnique, France).

614 Multiscale Method in Heat Shock Model

Hye Won Kang, Mathematics, University of Wisconsin, Madison

A reaction network contains multiple reactions and chemical species. The number of molecules can be modeled stochastically using continuous time Markov processes. Since the abundance of the number of each molecule is different, we apply multiscale method. We scale the number of molecules and the reaction rates, and apply various time changes using the same scaling parameter N. By averaging and law of large number, fast and slow components are separated. We choose different time scales, and each time scale gives us a system of sub network which is a reduced system from the original whole network. By using multiscale method, we can reduce the dimensionality of complex models. In this talk, I apply multiscale method to Heat Shock model. With the assumption that maximal orders of inputs and outputs for each species are the same, we get a general set of solutions regarding to exponents in a scaling parameter N, and this solution gives us a scaled limit of the number of species with constant order after normalization. I will show one specific example of the set of the solution for exponents, and will solve each sub network which either has Poisson stationary distribution or is a solution of ordinary differential equations.

616 Markovian Embeddings of Non-Markovian Random Strings

Manuel Lladser, Applied Mathematics, University of Colorado

Let A be a finite set and X be any sequence of A-valued random variables. We show that it is always possible to embed X into a non-trivial first-order homogeneous Markov chain with a countable (possibly finite) state space. The embedding we propose is amenable for tracking the generating functions of various statistics associated with the occurrence of regular patterns (i.e. patterns described by a regular expression on the alphabet A) in X. Furthermore, it results in the least possible state-space size when X is a k-th order homogeneous Markov chain. We motivate our results by considering a non-Markovian model for GC-content regulation in DNA sequences. We analyze this model thoroughly and determine non-Gaussian asymptotic laws that are tested against genome data in bacteria. Work-in-progress regarding minimal embeddings of general non-Markovian sequences X will also be addressed.

622 Subordinate Killed and Killed Subordinate Process

Zoran Vondracek, Mathematics, University of Zagreb, Croatia

The subordinate killed process (SKP) is obtained by first killing a strong Markov processes upon exiting an open set and then by subordinating the killed process via an independent subordinator. On the other hand, for the killed subordinate process (KSP) these two operations are reversed: First one subordinates the strong Markov process via an independent subordinator and then kills it upon exiting the open set. In this talk we discuss the precise relationship between these two processes. It is known from before that the SKP is subordinate to the KSP in the sense of semigroups, hence can be obtained by killing the KSP via a multiplicative functional. We show that in fact one can kill the KSP at a stopping time (in an appropriate filtration) to obtain the SKP. Moreover, the KSP can be recovered from the SKP by resurrecting it at most countably many times. We also compute the corresponding resurrection kernel.

624 Occupation Statistics of Critical Branching Random Walks in Z^d (d >= 2)

Xinghua Zheng, Department of Statistics, University of Chicago

We consider a critical nearest neighbor branching random walk on Z^d (d >= 2). Denote by V_m the maximal number of particles at a single site at time m, and by G_m the event that the branching random walk survives to generation m. We show that if the offspring distribution has finite n-th moment, then in dimensions d >= 3, conditional on G_m, V_m=O_p(m^(1/n)); and if the offspring distribution has exponentially decaying tail, then, conditional on G_m, (a) V_m=O_p(log m) in dimensions d> = 3, and (b) V_m=O_p((log m)^2) in dimension d=2. On the other hand, we show that if the offspring distribution is non-degenerate then P(V_m >= delta log m | G_m) -> 1 for some delta >0. Therefore, in dimensions d >= 3, if the offspring distribution has exponentially decaying tail then conditional on G_m, the distribution of {V_m/log m} must converge to a nontrivial limit as m -> infty. Furthermore, we show that, conditional on G_m, in dimensions d >= 3, the number of multiplicity-j sites, j >= 1, and the number of occupied sites, normalized by m, converge jointly to multiples of an exponential random variable; in dimension d = 2, however, the number of particles on a `typical' site is O_p(log m), and the number of occupied sites is O_p(m/log m). This is based on joint work with Steven P. Lalley.

630 Central Limit Theorem for Strictly Stationary Random Fields

Falaha Mouna, Sciences Fundamentals, Aleppo University, Faculty of Genie Electric, Syria

Central limit theorem for strictly stationary random fields is established under moment conditions. For proving the central limit theorem for random fields, a new technique of Martingale approximation for strictly stationary random fields is adopted; this technique replaced the traditional assumption of ergodicity of the random field by moment conditions, which is easy to check.

The interesting point of our work is that the ergodicity of random fields is not required, and it gives a new method of construction of a martingale for random fields.

It has been proved that the maximum pseudo-likelihood estimator for Markov random fields is asymptotically normal. Finally, simulation results are presented in order to illustrate our theatrical results.

634 Non-Linear SPDEs for Highway Traffic Flows

Guillaume Bonnet, Statistics and Applied Probability, University of California, Santa Barbara

Highway traffic flow has long been a prime example of successful modeling with PDEs. Models of various complexities have been proposed in the last few decades, typically derived by analogy of fluid dynamics. These models are often used by traffic engineers for road design, planning and management. However, such models are often hard to analyze and/or fail to capture important features of empirical traffic flow studies, particularly at small scales.

In this talk, I will propose a fairly simple stochastic model for highway traffic flow in the form of a nonlinear SPDE with random coefficients driven by a Poisson random measure. I will discuss the well posedness of the proposed equation and then move to the corresponding inverse problem by presenting some methods to calibrate the model to high resolution traffic data from highway 101 in Los Angeles.

641 Conditoned Stable Lévy Processes and Lamperti Representation

Maria Emilia Caballero, Instituto de Matematicas, University of Mexico

Based on a joint work with L. Chaumont.

By killing a stable Lévy process when it leaves the positive half-line, conditioning it to stay positive, and conditioning it to hit 0 continuously, we obtain three different, positive, self-similar Markov processes which illustrate the three classes described by Lamperti (1972). For each of these processes, we explicitly compute the infinitesimal generator and from this deduce the characteristics of the underlying Lévy process in the Lamperti representation. The proof of this result bears on the behaviour at time 0 of stable Lévy processes before their first passage time across level 0, which we describe here. As an application, for a certain class of Lévy processes we give the law of the minimum before an independent exponential time. This provides the explicit form of the spatial Wiener-Hopf factor at a particular point and the value of the ruin probability for this class of Lévy processes.

655 Portfolio Optimization under Partial Observations with Transaction Costs

Oana Mocioalca, Mathematics, Kent State University

We examine a two-asset portfolio optimization problem where the model for the stock price can have the features of bull or bear markets, and in which there are transaction costs that might inhibit the investor from trading too often. Only partial observations are allowed. The investment is over a fixed period of time and the power utility function is used.

667 Law of the Iterated Logarithm for Stationary Processes

Ou Zhao, Statistics, University of Michigan

In 2000 [Ann. Probab., 28, 713-724] Maxwell and Woodroofe investigated the conditional central limit questions for additive functionals of Markov chains. They established, among other things, a surprisingly weak condition for that, by only restricting the "growth" of conditional means; no other condition on the dependence structure is required. By slightly strengthening their condition, we justify the law of the iterated logarithm; and as a by-product, we obtain a "quenched" law as posed by Kipnis and Varadhan (1986) [Comm. Math. Phys., 104, 1-19], which is a improved version of the conditional central limit theorem. All of our results will apply to general stationary processes. The proof brings together a variety of techniques in different fields. The main tools are: Fourier analysis of renewal equations; perturbations of linear operators; and operator-theoretical ergodic theory. I will try to talk about all these connections, exhibit some interesting concrete examples, and, if time permits, report some recent progress on the conditional central limit questions. This is a joint work with Michael Woodroofe.

674 Stationary Solutions of the Burgers Equation with Random Boundary Conditions

Yuri Bakhtin, School of Mathematics, Georgia Tech

I shall consider the Burgers equation on a segment. Under random boundary conditions given by a stationary in time stochastic process I will show existence and uniqueness of a stationary solution. I will show that these properties result from a One Force One Solution principle which is in turn implied by a fast loss of memory in the system. I shall also discuss some properties of the stationary solutions and possible extensions to higher dimensions.

684 One-Factor Term Structure without Forward Rates

Victor Goodman, Mathematics, Indiana University

We construct a no-arbitrage model of bond prices where the long bond is used a a numeraire. We develop bond prices and their dynamics without developing any model for the spot rate or forward rates. The model is arbitrage free and all nominal rates remain positive in the model. We give examples where our model does not have a spot rate; other examples include both spot rates and forward rates.

Using local martingale techniques, we compute a formula for the price of interest rate caplets, and we compare our formula to the industry-standard formula for interest rate caps. This model is shown to be a reformulation of the well-known "exploding" model considered by Morton. We explain how the explosions are deferred.

685 Large Deviations for Partition Functions of Directed Polymers and Other Models

Iddo Ben-Ari, Mathematics, University of California, Irvine

Consider the partition function of a directed polymer in an IID field. It is well-known that under some mild assumption on the field, the free energy of the polymer is equal to some deterministic constant for almost every realization of the field and that the upper tail of the large deviations has an exponential tail. In this talk I'll dicsuss the lower tail of the large deviations (LTLD). In a recent work, Cranston, Gautier and Mountford have obtained estimates on the LTLD for the one-dimensional Gaussian case as well as for fields which are "almost" positive, in some appropriate sense. I'll present a new method for obtaining estimates on the the LTLD. As a consequence, the LTLD exhibits three regimes, determined by the tail of the negative part of the field. The method can be applied to other oriented and non-oriented models, including point-to-point first passage percolation.

697 Martingale Approximation and the Functional Central Limit Theorem

Dalibor Volny, Department of Mathematics, Université de Rouen, France

We shall deal with the central limit theorem and the invariance principle for functionals of a stationary and homogeneous Markov chain. The limit theorem is called quenched if it holds for almost all starting points. The quenched versions of limit theorems of Maxwell and Woodroofe, Derriennic and Lin, and Wu and Woodroofe will be discussed.

698 Nonsynchronous Covariation with Application to High-Frequency Finance

Takaki Hayashi, Graduate School of Business Administration, Keio University, Japan

There has been growing importance of the use of high-frequency data in financial risk management for the last decade. Among notorious feature of such data is nonsynchronicity, i.e., market prices are recorded at irregular times in a nonsynchronous manner, a reflection of the reality of actual trading. This feature can be problematic when methods developed for synchronous data are applied.

In this study, we tackle a statistical estimation problem of the covariance for high-frequency data. We formulate the problem in a framework with semimartingales sampled at nonsynchronous stopping times. The results extend the existing studies on realized volatility type estimators that are based on synchronous samples. (Joint work with Professor Nakahiro Yoshida.)

717 A Proof of the Smoothness of the Finite Time Horizon American Put Option for Jump Diffusions

Erhan Bayraktar, Mathematics, University of Michigan

We construct an increasing sequence of functions that converge to the value function of the American put uniformly and exponentially fast and use this scheme to prove our results.

723 Bridges of Lévy Processes Associated to Lévy Forests

Loïc Chaumont, Mathématiques, Université d'Angers, France

The genealogy of a Lévy forest of size s conditioned to have a mass equal to 1 may be coded by the first passage bridge with length 1 from 0 to –s of a Lévy process with no negative jumps.

In the stable case, we give a path construction of this bridge from the initial process. This allows us to obtain a construction of the conditioned forest from the initial one.

Then, we will present an invariance principle for the conditioned forest by considering k independent Galton-Watson trees whose offspring distribution is in the domain of attraction of a stable law conditioned on their total progeny to be equal to n. We prove that when n and k tend to infinity, under suitable rescaling, the associated coding random walk converges in law on the Skohorod space towards the first passage bridge of a stable Lévy process with no negative jumps.

739 Dynamics under Fast Scale Random Boundary Conditions

Jinqiao Duan, Department of Applied Mathematics, Illinois Institute of Technology

As a model for multiscale systems under random influences on physical boundary, a stochastic partial differential equation under a fast random dynamical boundary condition is investigated.

An effective equation is derived and justified by reducing the random dynamical boundary condition to a simpler random boundary condition. The effective model is still a stochastic partial differential equation. Furthermore, the quantitative comparison between the solution of the original stochastic system and the effective solution is provided by deviation estimates.

740 Lebesgue Measure and Computation of Hausdorff Dimension

Ming Yang, University of Illinois at Urbana-Champaign

Complete answers to some difficult questions concerning the Hausdorff dimension of random sets, including the image of an additive process, the k-multiple time set and the k-multiple point set of a Levy process are given.

757 Portmanteau Test of Independence for Functional Observations

Robertas Gabrys, Mathematics and Statistics, Utah State University

In a number of fields, most notably finance and physical sciences, the time series of finely spaced measurements form curves over some natural time interval, e.g. a day or a week. Recent years have seen the development of tools for analyzing such data which rely on concepts of Functional Data Analysis. To validate the assumptions underlying these tools, it is important to apply some test of independence to functional model errors or to suitably transformed functional observations. We propose a chi-squared test for independence and identical distribution which extends to the functional framework a well{established univariate test. The test is easy to implement using the R package fda and relies on the now standard functional principal component decomposition. It has good empirical size and power which, in our simulations and examples, is not affected by the choice of the functional basis. Its application is illustrated on two data sets: credit card sales activity and geomagnetic records. Asymptotic theory based on correlations of matrix valued random variables, functional principal component expansions and Hilbert space techniques is developed.

758 A Stochastic Lagrangian Representation of the 3-Dimensional Incompressible Navier-Stokes Equations

Gautam Iyer, Mathematics, Stanford University

In this talk I will derive a stochastic representation of the Navier-Stokes equations based on `noisy particle paths.

Roughly speaking the representation can be thought of as perturbing an inviscid flow with the Weiner process and averaging. This leads to the physical interpretation of viscous fluids as inviscid fluids plus Brownian motion of the fluid particles. I will discuss a few consequences of this representation.

759 1D Schrodinger Operators with the Levy Type Potentials

Stanislav Molchanov, Math and Statistics, University of North Carolina, Charlotte

We consider the piece-wise constant random potentials where either the distribution of the heights of the bumps or the distribution of the distances between them have the heavy tails. In this case the density of states and the Ljapunov exponent have a completely different structure than the one in the standard localization theory.

767 Large Deviations for Infinite Dimensional Stochastic Dynamical Systems

Vasileios Maroulas, Statistics & Operations Research, University of North Carolina, Chapel Hill

Freidlin-Wentzell theory, one of the classical areas in large deviations, deals with path probability asymptotics for small noise stochastic dynamical systems. For finite dimensional stochastic differential equations (SDE) there has been an extensive study of this problem. In this work we are interested in infinite dimensional models, i.e. the setting where the driving Brownian motion is infinite dimensional. In recent years there has been lot of work on the study of large deviations principle (LDP) for small noise infinite dimensional SDEs, much of which is based on the ideas of Azencott (1980). A key in this approach is obtaining suitable exponential tightness and continuity estimates for certain approximations of the underlying stochastic processes. This becomes particularly hard in infinite dimensional settings where such estimates are needed with metrics on exotic function spaces (e.g. Hälder spaces, spaces of diffeomorphisms etc).

Our approach to the large deviation analysis is quite different and is based on certain variational representation for infinite dimensional Brownian motions. It bypasses all discretizations and/or finite dimensional approximations and thus no exponential probability estimates are needed. Proofs of LDP are reduced to demonstrating basic qualitative properties (existence, uniqueness and tightness) of certain perturbations of the original process. The approach has now been adopted by several authors in recent works to study various infinite dimensional models such as stochastic Navier-Stokes equations, stochastic flows of diffeomorphisms, SPDEs with random boundary conditions, etc.

In this talk we illustrate our method for a class of stochastic reaction-diffusion equations. We show that our approach does not require the restrictive boundedness condition on the diffusion coefficient, or the "cone condition" on the underlying domain, that have been assumed in previous works on this problem.

783 Superprocesses under a Stochastic Flow

Carl Mueller, Mathematics, University of Rochester

For a superprocess under a stochastic flow in one dimension, we prove that there exists has a density with respect to the Lebesgue measure. A stochastic partial differential equation is derived for the density. The regularity of the solution is then proved by using Krylovs L_p-theory for linear SPDE. This is joint work with K. Lee and J. Xiong.

804 Heavy Traffic Scaling and Limit Models in Wireless Systems with Long Range Dependence

Robert Buche, Mathematics, North Carolina State University

High-speed wireless networks carrying applications with high capacity requirements (such as multimedia) are becoming a reality where the transmitted data exhibit long range dependence and heavy-tailed properties. We obtain heavy traffic limit models incorporating these properties, extending from previous results limited to short range dependence and light-tailed cases. An infinite source Poisson arrival process is used and fundamental inequality between the exponent in the power tail distribution of the data from source and the rate of channel variations in the departure process is obtained. This inequality is important for determining the heavy traffic scaling in both the ``fast growth" and ``slow growth" regimes for the arrival process, and along with the source rate, define the possible queueing limit models —across the cases, they are reflected stochastic differential equations driven by Brownian motion, fractional Brownian motion, or stable Levy motion.

813 On the Theory and Applications of Truncated Skew Laplace Distribution

Gokarna Aryal, Math, CS and Statistics, Purdue University, Calumet

A random variable X follows the skew-Laplace probability distribution, if its probability density function, pdf, is f(x)=2g(x)G(\lambda x), where g(.) and G(.) denote the pdf and cdf of the Laplace probability distribution and \lambda is a shape parameter introduced in the model. In the present study we develop the theory when the skew-Laplace pdf is truncated to the left from the origin. The results are applied to real data and it is also shown that the analytical results are quite useful in the maintenance systems.

830 Are Volatility Estimators Robust with Respect to Modeling Assumptions?

Yingying Li, Department of Statistics, University of Chicago

We consider microstructure as an arbitrary contamination of the underlying latent securities price, through a Markov kernel Q. Special cases include additive error, rounding, and combinations thereof. Our main result is that, subject to smoothness conditions, the two scales realized volatility (TSRV) is robust to the form of contamination Q. To push the limits of our result, we show what happens for some models involving rounding (which is not, of course, smooth) and see in this situation how the robustness deteriorates with decreasing smoothness. Our conclusion is that under reasonable smoothness, one does not need to consider too closely how the microstructure is formed, while if severe non-smoothness is suspected, one needs to pay attention to the precise structure and also to what use the estimator of volatility will be put.

846 Estimation of the Offspring Mean in Controlled Branching Processes

Ines del Puerto, Mathematics, University of Extremadura, Spain

The controlled branching process (CBP) with random control function provides a useful way to model generation sizes in population dynamics studies, where control on the growth of the population size is necessary at each generation. From a probabilistic viewpoint and in the framework of asymptotic linear growth of the expectation of the control variables, this model has been well studied. One of the main parameters describing the evolution of these models is known as the offspring mean. As in classical Galton-Watson process, this plays a crucial role as a threshold parameter, which drastically changes the behavior of the process in the three cases known as subcritical, critical and supercritical. However, few papers deal with the study of inference problems arising in this model. A first approach to these problems was established by Dion and Essebbar (see Lecture Notes in Statistics, 99, pp 14-21(1995)) by considering a particular case of control function. Motivated by the work of Wei and Winnicki (Ann. Statist. vol 18. pp 1757-1773.(1990)), recently, Sriram et al. (see Sriram, T.N., Bhattacharya, A., González, M., Martínez, R., and del Puerto, I. (2007). Estimation of the Offspring Mean in a Controlled Branching Process with a Random Control Function. Stochastic Process. Appl. (accepted to publish)) provided a unified estimation procedure to allow inference without the knowledge of the range of the offspring mean. In this talk, we present the weighted conditional least squares estimator of the offspring mean proposed in Sriram et al. (2007) and derive the asymptotic limit distribution of the estimator in the critical case.

881 Bayesian Inference for Software Reliability Models with Reference Prior

Ashkan Ertefaie, Mathematics, Stuttgart University, Germany

883 Optimal Stopping and Free Boundary Characterizations for Some Brownian Control Problems

Kevin Ross, Department of Statistics, Stanford University

We study a singular stochastic control problem with state constraints in two-dimensions. We show that the value function is continuously differentiable and its directional derivatives are the value functions of certain optimal stopping problems. Guided by the optimal stopping problem we then introduce the associated no-action region and the free boundary and show that, under appropriate conditions, an optimally controlled process is a Brownian motion in the no-action region with reflection at the free boundary. This proves a conjecture of Martins, Shreve and Soner (1996) on the form of an optimal control for this class of singular control problems. An important issue in our analysis is that the running cost is Lipschitz but not continuously differentiable. This lack of smoothness is one of the key obstacles in establishing regularity of the free boundary. We show that the free boundary is Lipschitz and if the Lipschitz constant is sufficiently small, a certain oblique derivative problem on the no-action region admits a unique viscosity solution. This uniqueness result is key in characterizing an optimally controlled process as a reflected diffusion in the no-action region. (Joint work with Amarjit Budhiraja.)

888 Asymptotic Results on the Length of a Coalescent Tree

Jean-Stephane Dhersin, MAP 5, Université Paris Descartes, France

We consider Λ-coalescents including the Beta coalescent with parameter $\alpha\in(1,2)$. Denote by τ_n the number of coalescence times of the n-coalescent. Using martingale arguments, we prove that $n^{-1/\alpha}(n-\tau_n/{(\alpha-1)})$ converges in distribution to an α-stable r.v. We also consider $L^{(n)}_t$ the total length of the n-coalescent up to the $\lfloor nt \rfloor$-th coalescence. For $t<\alpha-1$, we get that $n^{-2+\alpha}L^{(n)}_t$ converges in probability to a limit, say $a(t)$. We prove that for α small enough the process $L^{(n)}_n-a(t)n^{2-\alpha}$ properly rescaled has a non trivial limit in distribution. In the case of neutral mutations, we use this result to describe asymptotic behaviour of the number of mutations. This is a first step to get an estimator of the rate of mutation.

891 The Scaling Limit of Fomins Identity for Two Paths in the Plane

Michael Kozdron, Mathematics and Statistics, University of Regina, Canada

We review some recent work that establishes the scaling limit of Fomins identity for loop-erased random walk on Z^2, and in the case of two paths prove directly that the corresponding identity holds for chordal SLE(2). This talk is based on joint work with G. Lawler of the University of Chicago.

892 Convergence of an Approximate Hedging Portfolio with Liquidity Risk

Kiseop Lee, Mathematics, University of Louisville

Under the model with liquidity risk, we consider a hedging strategy that approximates the Black-Scholes hedging strategy and produces relatively small liquidity cost. We compute the rate of convergence of the final value of the new hedging portfolio to the option payoff in case of a European call option; {\it i.e.} we see how fast its hedging error converges to zero. The hedging strategy studied here is meaningful due to its simple liquidity cost structure that is fixed at the initial time and its smoothness relative to the Black-Scholes delta.

893 Brownian Super-Exponents

Victor Goodman, Mathematics, Indiana University

We introduce a transform on the class of stochastic exponentials for d-dimensional Brownian motions. Each stochastic exponential generates another stochastic exponential under the transform.

The new exponential process is often merely a supermartingale even in cases where the original process is a martingale. We determine a necessary and sufficient condition for the transform to be a martingale process. The condition links expected values of the transformed stochastic exponential to the distribution function of certain time-integrals.

898 Explosion Question for Branching Processes Associated with Navier-Stokes Equations

Chris Orum, CCS-3, Information Sciences, Los Alamos National Laboratory

Solutions of the Fourier transformed Navier-Stokes equations (within a certain class of solutions) admit representation as the expected value of a multiplicative functional defined on a branching process. This was discovered by Le Jan and Sznitman (1997). The branching process in question is a continuous-time multi-type branching processes in which particle life is exponentially distributed, particle types are indexed by Fourier space variables, and the probability law of the replacement particles is given by the integrand of a normalized convolution integral. In 2003 Bhattacharya, et al. extended this representation result with the introduction of a class of functions known as majorizing kernels, and in doing so introduced a class of multi-type branching processes with "convolution branching mechanism". Left open was the possibility that such branching processes may explode (produce an infinite number of particles in finite time). This explosion issue, and its context, will be addressed.

901 A Rate of Convergence for the Lagrangian Averaged Regularization of Navier-Stokes

Ed Waymire, Mathematics, Oregon State University

The Lagrangian Averaged Navier-Stokes equation is a regularization, depending on a parameter alpha => 0, of Navier-Stokes equations (alpha = 0) designed as a turbulence model in place of Navier-Stokes for numerical computations. In this talk we will indicate how to use a combination of probabilistic and

functional/harmonic analysis to obtain (small ball) global existence, uniqueness and a rate of convergence as alpha >0 to Navier-Stokes. This is based on joint work with Larry Chen, Ronald Guenther, Enrique Thomann at OSU, and Sun-Chul Kim, Chung Ang University.

914 Heat Kernel Analysis on an Infinite-Dimensional Heisenberg Group

Masha Gordina, Mathematics, University of Connecticut

This is a joint work with B.Driver. The group in question is modeled on an abstract Wiener space. Then a group Brownian motion is defined, and its properties are studied in connection with the geometry of this group. The main results include quasi-invariance of the heat kernel measure, log Sobolev inequality (following a bound on the Ricci curvature), and the Taylor isomorphism to the corresponding Fock space.

923 Approximation of Lévy Processes and Orthogonal Polynomials

Frederic Utzet, Mathematics, Universitat Autonoma de Barcelona, Spain

Consider a Lévy process X with moment generating function. Associated with its Lévy measure it can be constructed a family of orthogonal polynomials that plays an important role at different places. In this talk, we will show that using the Gauss-Jacobi mechanical quadrature formula and other classical results of orthogonal polynomials, we can construct a sequence of simple Lévy processes that converges to X in a very good sense; specifically, that all iterated integrals and variations of the elements of the sequence converge in the Skorohod sense to the corresponding ones of the limit. From this result it follows that many functionals of the Lévy process can be conveniently approximated.

950 About Timescale Used for the Discretization of Stochastic Volatility Models

Ionut Florescu, Mathematics, Stevens Institute of Technology, New Jersey

When estimating parameters for continuous time diffusion processes one has to use discrete data and therefore has to calculate the finite dimensional distribution of the stochastic process. It is common to use an annual time scale for high level tasks such as derivative pricing, portfolio management and hedging, however for low level tasks such as estimation of the coefficients present in the model the time is usually expressed in days. We will show that this dichotomy introduces bias and indetermination in the parameters estimated form the daily model and later converted to the annual model. We will also point out discrepancies in some discretized models that are currently used in practice in the hope that a better specification will be used in the future.

951 A Random Walk on Integers with a Drift Driven by its Occupation Time at Zero

Alexander Roitershtein, Mathematics, University of British Columbia, Canada

We consider a nearest-neighbor random walk X_n on integers, and we assume that the drift of the random walk at time n equals to -sign(X_n)L_n^{-a}, where L_n is the occupation time of the walk at zero up to time n and a>0 is a parameter.

If a<1, we show that the functional central limit theorem with standard normalization sqrt{n} holds for X_n. In addition, we prove that the law of the sequence (X_n) is equivalent to the distribution of the simple random walk in this case.

If a>1 we show that, X_n/n^b converges in distribution to a non-degenerate law for b=a/(1+a). Furthermore, if M_n denotes the maximum of the walk up to time n, we prove that M_n/(b_n log n) converges to a positive constant, in probability. Finally, we show that limsup X_n/(b_n log n) converges a.s. to the same positive constant.

This is a joint work with Iddo Ben-Ari (UC Irvine) and Mathieu Merle (UBC).

952 Simulation-Based Optimization of Markov Decision Processes: An Empirical Process Theory Approach

Rahul Jain, Operations Research, IBM Research, New York

It is well-known that solving Markov decision processes using dynamic programming is computationally intractable. We propose a simulation-based framework that exploits the uniform laws of large numbers developed by Vapnik-Chervonenkis, and others. The Vapnik-Chervonenkis theory is a generalization of the classical Glivenko-Cantelli theorem. They obtained necessary and sufficient conditions for a uniform law of large numbers to hold for a class of measurable Boolean functions. This was later extended to bounded real-valued functions by Pollard and others. It was shown that the rate of convergence depends on the epsilon-covering number of the function class introduced by Kolmogorov and Tihomirov.

We present the beginnings of a corresponding empirical process theory for Markov decision processes. We provide uniform law of large number results for particular functionals of Markov decision processes. When uniform convergence is obtained, we also obtain the rate of convergence in terms of P-dimension of the policy class. Surprisingly, we find that how sample trajectories of a Markov process are obtained from simulation matters for uniform convergence: There are good simulation models (for which one may get uniform convergence) and bad simulation models (for which one may not get uniform convergence for the same set of Markov processes). This phenomenon seems to be the first such observation in the theory of empirical processes. Uniform convergence results are also obtained for the average reward case, for some partially observed processes, and for Markov games.

We then introduce a simulation-based framework for optimization of Markov decision processes. In particular, we give an simulation-based algorithm to compute epsilon-optimal policy and show the regret minimization property of such a framework. We then show its application to a class of Multi-armed bandit problems.

960 Dimension and Natural Parametrization for SLE Curves

Gregory Lawler, Mathematics, University of Chicago

I will discuss recent work on SLE curves including two main results:

1. A new proof of the lower bound for the Hausdorff dimension of SLE paths

2. For certain values of kappa, the existence of a "natural parametrization" that corresponds roughly to the scaling limit of the "length" of the path. (This is joint with Scott Sheffield.)

969 Negative Moments for a Linear SPDE

Carl Mueller, Mathematics, University of Rochester

When using Malliavin Calculus, we often differentiate the original equation to obtain a linear equation for the derivative. Next, among other things, we study the moments of the derivative. Following this motivation, we study the negative moments of solutions to a linear SPDE, and show that the moments are finite in some cases.

984 Optimal Dividend Policy in the Presence of Business Cycles

Luz Sotomayor, Mathematical and Statistical Sciences, University of Alberta, Canada

We consider a dividend payment problem when the company presents different regimes that affect its cash reservoir. The company has to choose the optimal rate for paying dividends that maximizes the total expected discounted cumulative amount of dividends paid-out to shareholders. We consider the case of unbounded dividend rates, which generates a singular stochastic control problem with regime switching. The optimal dividend process is given then as the solution of a Skorohod problem for one-dimensional diffusions with regime switching.

985 Equilibrium Pricing in Incomplete Markets

Patrick Cheridito, Department of Operations Research & Financial Engineering, Princeton University

We derive equilibrium prices for options in incomplete markets for agents with mean-risk preferences. Explicit formulas are given for equilibrium pricing measures in different incomplete discrete-time models, and the corresponding option prices are discussed. The approach leads to option prices with realistic volatility smiles.

990 Hitting Probabilities of Anisotropic Gaussian Random Fields

Yimin Xiao, Department of Statistics and Probability, Michigan State University

This talk is concerned with hitting probabilities for anisotropic Gaussian random fields. There are two types of anisotropy, namely, anisotropy in the time-variable (in short, Type I) and in the space-variable (Type II), respectively.

The class of anisotropic Gaussian random fields of Type I includes fractional Brownian sheets and solutions to stochastic heat equation driven by space-time white noise. The class of anisotropic Gaussian random fields of Type II includes the operator-self-similar fractional Brownian motion constructed in Mason and Xiao (2002).

We derive hitting probabilities for these two types of Gaussian fields and show their applications in determining the fractal dimensions and escape rates of the sample functions.

993 Recursive Estimation of Stochastic Processes

Wei Biao Wu, Statistics, University of Chicago

For statistical inference of means of stationary processes, one needs to estimate their time-average variance constants (TAVC) or long-run variances. For example, in MCMC simulations, one generates a Markov Chain and uses the sample mean to estimate the population mean. Under suitable conditions, the sample mean satisfies a central limit theorem (CLT) and the asymptotic variance in the CLT called TAVC or long-run variance. Estimation of TAVC is important in constructing confidence intervals which are useful in convergence diagnostics of MCMC. It is well-known that the sample mean can be updated recursively. However, the classical TAVC estimate which is based on batched means does not allow recursive updates and the required memory complexity is $O(n)$. Consequently, a majority of the CPU time is spent on the computation of TAVC estimates. In this talk, I will present a recursive algorithm for TAVC and discuss its convergence properties.

994 Moderate Deviation for Stationary Sequences

Magda Peligrad, Professor of Mathematics, University of Cincinnati, Ohio

The Moderate Deviation Principle is an intermediate behavior between the central limit theorem and Large Deviation. Usually, MDP has a simpler rate function, inherited from the approximated Gaussian process, and holds for a larger class of dependent random variables than the large deviation principle. Based on a modification of the martingale approximation approach, that allows to avoid the coboundary decomposition, we enlarge the class of dependent sequences known to satisfy the moderate deviation principle. Recent or new exponential inequalities are applied to justify the martingale approximation. The conditions involved in our results are well adapted to a large variety of examples, including regular functionals of linear processes, expanding maps of the interval and symmetric random walks on the circle. This talk is based on joint works with Jérôme Dedecker, Florence Merlevède, and Sergey Utev.

995 A Characterization of Dynamic Forward Utilities

Michael R. Tehranchi, Statistical Laboratory, Centre for Mathematical Sciences, University of Cambridge, UK

Recently, the notion of dynamically consistent utility functions has appeared in the mathematical finance literature, as forward utility functions in Musiela and Zariphopoulou and time-unbiased utility functions in Henderson and Hobson. We present an explicit characterization of dynamic forward utility functions in a general incomplete market when the asset prices are continuous. This work is joint with Francois Berrier and Chris Rogers.

Exhibitors

Organizers of the *Stochastic Processes and Their Applications* conference welcome the exhibitors listed below. We encourage all conference participants to visit these exhibitors' displays during refreshment breaks and other break times. Exhibitors are listed in alphabetical order.

Cambridge University Press—Advances learning, knowledge and research worldwide

Cambridge University Press was founded by a royal charter granted to the University of Cambridge by King Henry VIII in 1534. It is the oldest printer and publisher in the world, having been operating continuously since 1584, and is one of the largest academic publishers globally.

Academic Publishing: Cambridge is one of the world's largest and most prestigious academic publishers and is acclaimed for its list of journals, textbooks, monographs, and practitioner guides, in subjects from medicine and law to literature and classics. Cambridge's academic publishing includes around 200 journals, around 1200 new books each year, and its historic Bibles list.

For more information, please visit the Cambridge University Press Web site at *www.cambridge.org/us.*

ELSEVIER—Building Insights, Breaking Boundaries

As the world's leading publisher of science and health information, Elsevier serves more than 30 million scientists, students, and health and information professionals worldwide.

We are proud to play an essential role in the global science and health communities and to contribute to the advancement of these critical fields. By delivering world-class information and innovative tools to researchers, students, educators and practitioners worldwide, we help them increase their productivity and effectiveness. We continuously make substantial investments that serve the needs of the global science and health communities.

For more information, please visit the ELSEVIER Web site at *www.elsevier.com.*

Taylor & Francis Group

Taylor & Francis, founded in the City of London in 1798, is the oldest commercial journals publisher in the world, and one of the leading global academic publishers. Building on two centuries' experience, Taylor & Francis has grown rapidly over the last two decades to become a leading international academic publisher. With offices in London, Brighton, Basingstoke, and Abingdon in the UK, New York and Philadelphia in the USA, and Singapore and Melbourne, Australia in the Pacific Rim, the Taylor & Francis Group publishes more than 1000 journals and around 1,800 new books each year, with a books backlist in excess of 20,000 specialist titles.

We are providers of quality information and knowledge that enable our customers to perform their jobs efficiently, continue their education, and help contribute to the advancement of their chosen markets. Our customers are researchers, students, academics and increasingly professionals.

For more information, please visit the Taylor & Francis Group Web site at *www.taylorandfrancisgroup.com.*

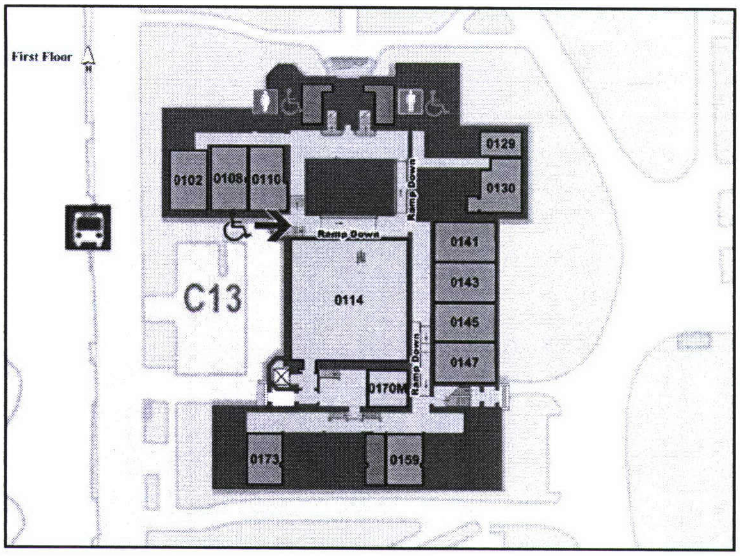
CAMBRIDGE UNIVERSITY PRESS

Taylor & Francis Group
an informa business

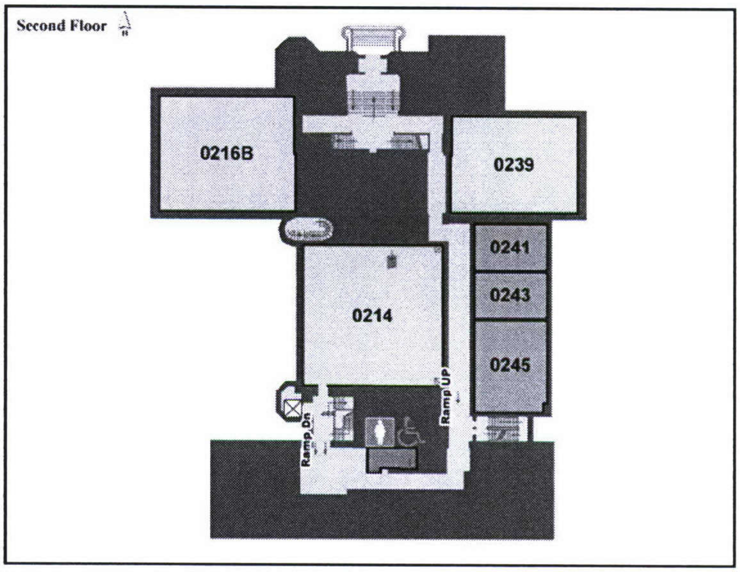
ELSEVIER

Altgeld Hall

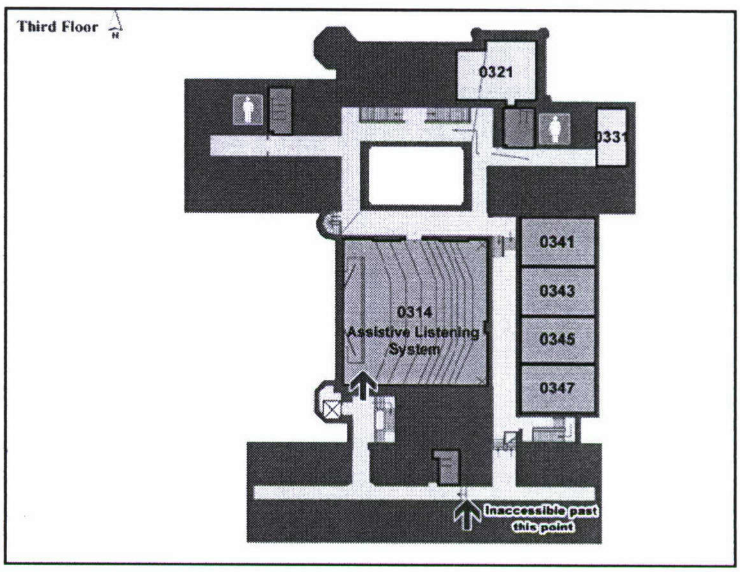
First Floor



Second Floor

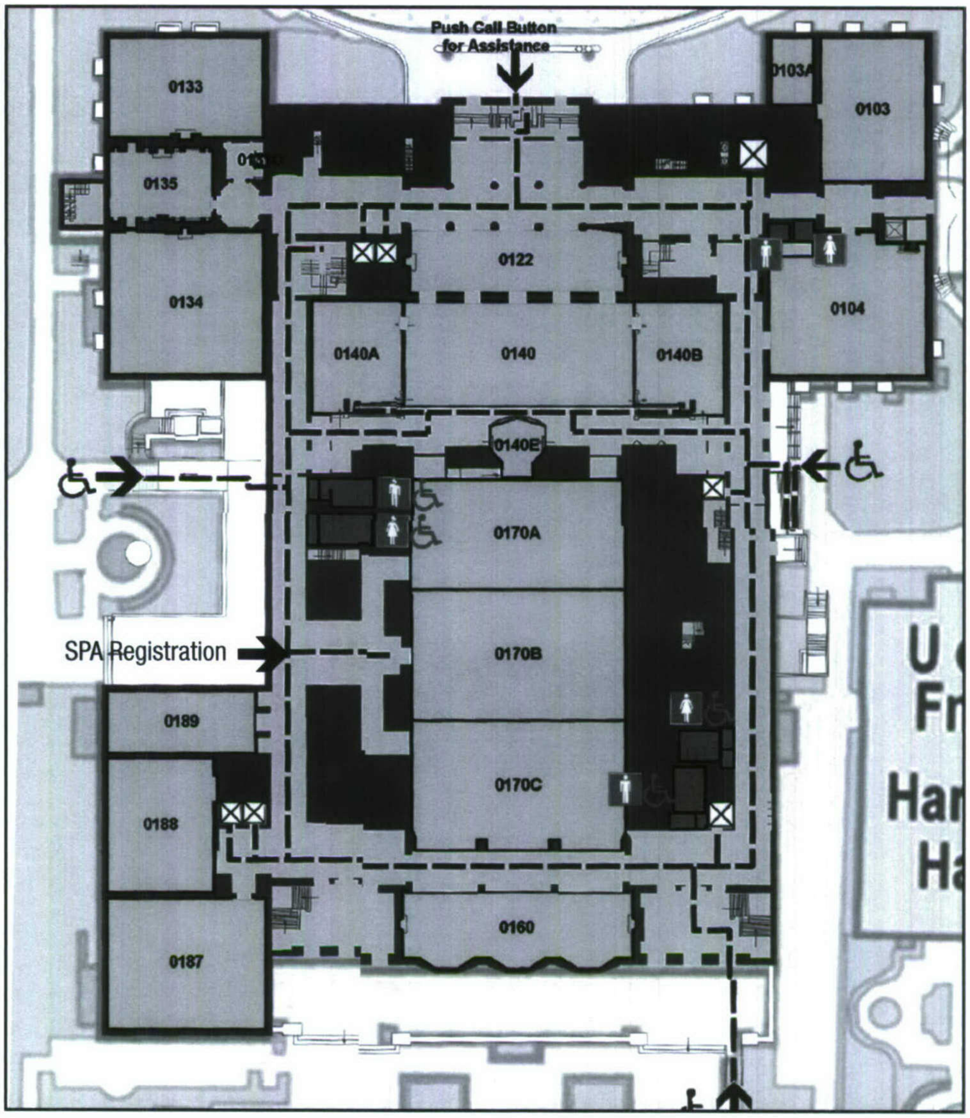


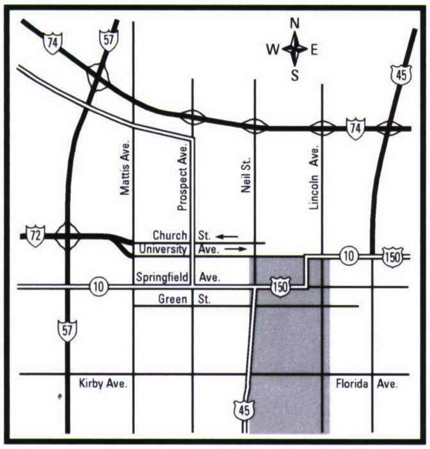
Third Floor



Illini Union

First Floor

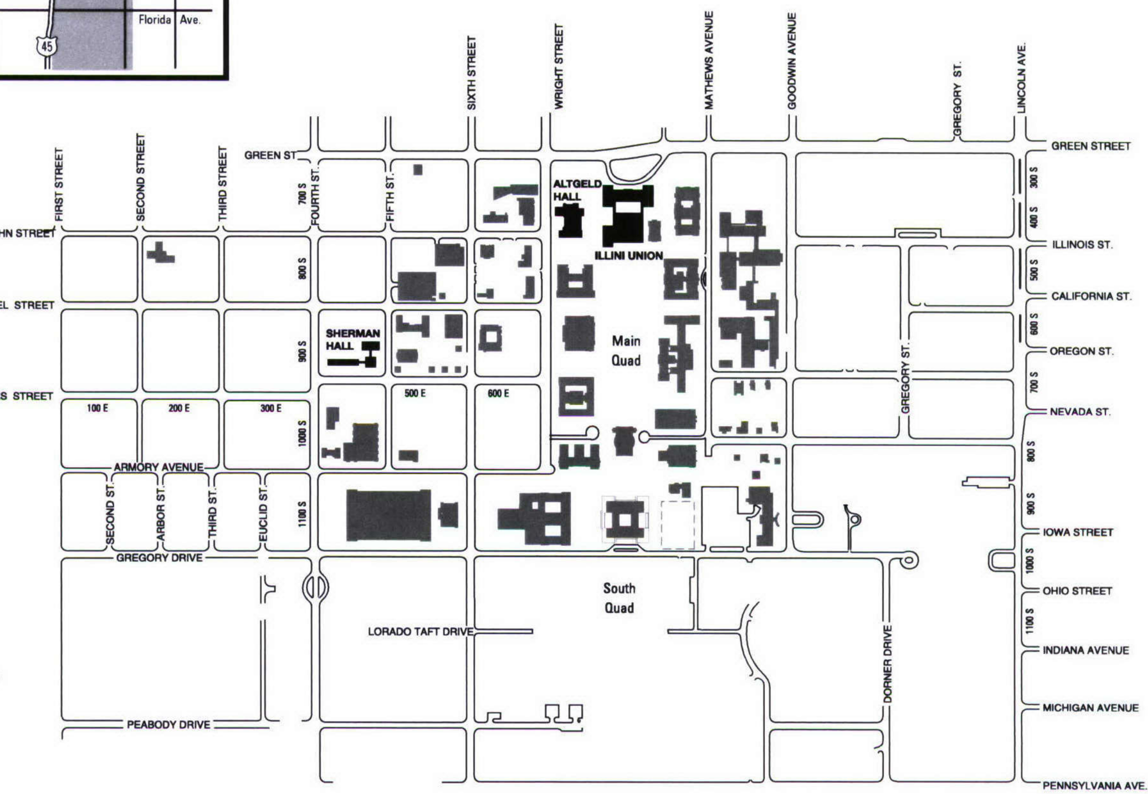




N

Urbana is east, Champaign is west of Wright Street

HAMPTON INN
1200 W. University Ave,
Urbana, Illinois, USA 61801
Tel: (217) 337-1100
Fax: (217) 337-1143



HAWTHORN SUITES
101 Trade Centre Drive
Champaign, IL 61820
Tel: (217) 398-3400
Fax: (217) 398-6147

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN